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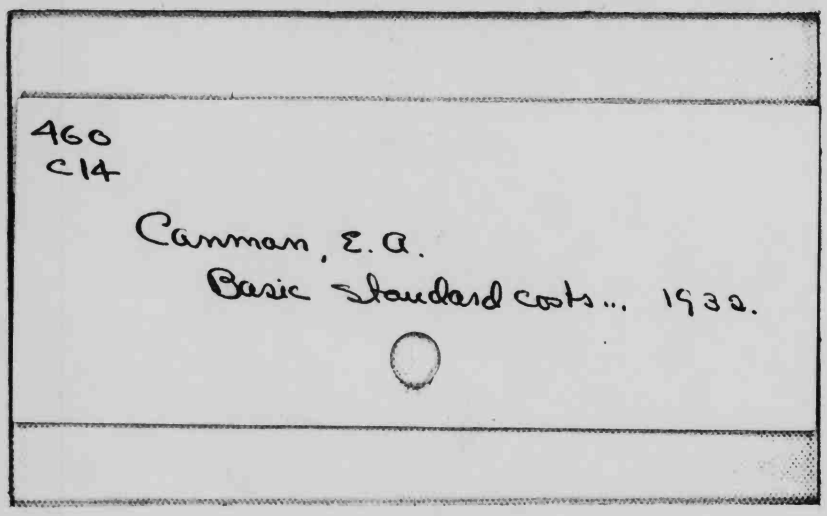

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BASIC STANDARD COSTS

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BASIC STANDARD COSTS

Basic Standard Costs

Control Accounting for Manufacturing Industries

By

ERIC A. CAMMAN, C.P.A.

Member, American Institute of Accountants,
Member, National Association of Cost Accountants.
Partner, Peat, Marwick, Mitchell & Co.

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EDITOR'S NOTE

The American Institute of Accountants through its committee on publication has approved the selection of the present volume, "Basic Standard Costs" by Eric A. Camman, as one of its principal texts for this year. A great many public accountants regard cost accounting as a field almost entirely distinct from any other in which accountants are concerned, and, as a consequence, there is a disposition to look upon cost accounting as without the range of the public accountant's interest. This tendency toward separation is less apparent today than it was ten or fifteen years ago. It is now fairly well understood that accounting and cost accounting, going hand in hand, may travel much further and render much better service than either one could alone. Consequently, whenever there is an important text upon a subject such as "Basic Standard Costs" it is not of interest exclusively to the cost accountant but rather to all accountants; and, of course, outside the accounting field it is of interest to everyone who is concerned with better business.

Strangely enough the phrase "standard costs" although it has been known for many years, is comparatively little understood. Only a small amount of discussion has taken place and the volume of writings on the subject is small. It seemed to the committee on publication that if there could be a fairly authoritative treatise upon this constantly growing subject it would be most desirable to publish it. And, accordingly, Mr. Camman, who is known as an author throughout the country and to some extent abroad, was invited to prepare the text which is now presented by the Institute's committee.

Great effort has been made to present the subject in a clear and not too dogmatic manner. The necessary charts which must accompany such texts are reduced to the least possible number and those which should be constantly consulted during the reading of the

book are not bound as an integral part of the volume but presented separately, so that they may be used most conveniently.

The committee on publication feels a sense of peculiar gratification in presenting this book which it believes to be the most comprehensive treatise on the subject of standard costs which has yet been written.

A. P. Richardson, *Editor.*

New York, May, 1932.

PREFACE

The principles described in this text should be of interest to all business men, whether in the province of administration or accounting. Executives who have to decide upon matters of policy, involving the responsibility of wise leadership upon which success or failure in business depends, know the importance of clear and true information as to facts in reaching conclusions. Those who have to see that the decisions are carried out effectively, and maintained so that the objectives shall be realized, know the difficulty of obtaining data useful for control in management. And accountants, who have the duty of furnishing the figures and interpreting their meaning, know the need for developing means of meeting these requirements abreast with the times and sensitive under changing conditions.

It is not generally understood that the procedures advanced under the rather inapt term "standard costs" are in reality applicable to all phases of management and are not confined in scope to cost finding alone. Standard cost accounting concerns operations of all descriptions, from the inception of investment to the final analysis of return, and is closely linked with budgetary control. It is not a modification of other procedures so much as an intrinsically different method, both as to concept and practice, although of course in harmony with accepted principles of sound accounting that have grown out of experience. This difference and the resulting advantages arise mainly from the expedient of introducing constants, on the basis of which to analyze and compare variations from expected accomplishment and the trends of them. In part for this reason, the title "Basic Standard Costs" has been chosen, and in part for the reason that no better words have so far been adopted than the original two, ambiguous though they are.

Much material is condensed in comparatively few pages. No attempt is made to deal with matters of accounting routine, that is,

the mechanics of assembling the data, or with cost accounting principles and practices in general, all of which are available already in many published works. Marketing and distribution costs and the treatment of administrative expenses are not considered—these alone would make material for another book. Nor are the methods peculiar to any selected business displayed, because the presentation would be of limited usefulness. Methods, after all, must be devised to fit each case: once the underlying theory is understood, the problems remaining are those of application, upon which it is not possible to generalize. Therefore, effort has been directed toward clarifying the subject and bringing out the reasoning by which analyses of given conditions are made. Abstract figures are furnished for each step in analysis, up to the explanation of the difference between actual and expected gross profits, with the idea of unfolding progressively the various calculations by means of which the final interpretation of results is effected. Experience teaches that the best way to obtain a grasp of the subject is to follow out some examples in which the features being described appear in definite form. Thus, one not only understands the immediate purport of each use of certain data but as well obtains the insight necessary to visualize other uses, the possibilities of which are numerous.

Some new features are presented for the first time, so far as my knowledge goes, in the ascertainment of variations between actual and expected results without continual revisions in the standards and in the means for projecting the results of changed conditions upon profits.

Acknowledgment is due to Mr. Ernest L. Coleman, Mr. William G. Leahy and Mr. Arthur F. Happe, whose assistance in reviewing and criticizing many of the calculations is gratefully appreciated, and to Mr. Oscar Wagner for his painstaking work in drawing the charts and illustrations.

ERIC A. CAMMAN.

New York, June, 1932.

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BASIC STANDARD COSTS

CHAPTER I

THE DIFFERENCE BETWEEN JOB COSTS AND STANDARD COSTS

The Job-Cost Plan

The general plan of job-cost accounting, broadly described, is to collect the costs of manufacture under work orders. A manufacturing order is issued for each article of product to be made, stipulating the quantity among other specifications. The order is given a number to record expenditures and consumption of material on the job and a cost sheet is opened for it. Material is drawn from storerooms on requisitions bearing the work-order number, from which a record is kept on the cost sheet to accumulate the total cost of all material. Labor is charged to the job on time tickets, usually separately for each operation performed, and the time tickets are used as the means of distributing the payroll to the job cost sheet. Burden, or indirect manufacturing expense, is then distributed in various ways, by means of rates per man hour or machine hour or percentages relating to the data already accumulated on the job-order cost sheet. The total thus obtained represents the cost of the job and, when divided by the quantity of product turned out, represents the unit cost of production.

The procedure is the same whether the product is simple or complex, the only difference being that, when the product is simple, the cost accounting is completed in one step, figuratively speaking, that is, on one cost sheet, whereas when the product is complex numerous steps are necessary, entailing the keeping of many cost sheets, one for each part entering into the product, from which the respective part costs must be carried forward to assembly cost sheets for sub-assemblies and ultimately to a final cost sheet for the completely assembled article. But the steps are merely a multiplication of the

items to be identified and kept separate. The procedure is essentially (1) to distribute, (2) to collect, (3) to recapitulate and (4) finally to analyze and compare.

Disadvantages of the Job-Cost Plan

It would be foolish to hold that this procedure is without value and a waste of time on that account. Conducted with reasonable intelligence, the undertaking must inevitably result in a better understanding of costs of products and of operating conditions, if only from concentrating on the subject and studying its phases by analysis and comparison. Certainly job costs are a great deal better than none. It must also be remembered that job costing is the first and obvious method of attempting to identify the expenditures necessary in course of manufacture with the products turned out, and that it is only as the consequence of the development in cost accounting from this beginning that the great advances have been made which are to be found in modern American industrial accounting practice. In considering the disadvantages inherent in the job-costing plan, therefore, one is concerned primarily with the difficulties which arise as the accompaniment of progress in the art of accounting and with their elimination by devising still better procedure.

One disadvantage of the job-cost plan is the length of time necessary to distribute and collect the data. The work must be finished and the lot completed before the total cost can be recapitulated and reduced to unit costs for comparison and analysis. This may be long after the product has been made and perhaps after it has been sold and shipped. The delay greatly depreciates the usefulness of the information, and it is frequently the case for this reason that supplementary manufacturing data are obtained for use in the interim.

Great difficulty of analysis when the figures are finally obtained is another disadvantage. The unit costs which have been recapitulated will show variations on comparison with past performances or, if they do not, they will almost certainly contain variations which are hidden. In order to ascertain the extent of these variations and what their causes were the unit cost, which has been so painstakingly compiled, must be laid aside, and a detailed study must be made of the elemental figures which were collected. The comparison must be made by elements in order to have any meaning whatever, and, even then, the process of discovery has somewhat of the difficulty of finding an old penny in a plowed field.

Variations in unit costs are frequently artificial. They may arise from charges to the wrong order numbers or failure to report the basic information at all, and many a long hunt for the reason underlying a disparity will end in some such disappointment. But entirely aside from clerical errors, a variation may be introduced in the cost of a job, which in reality has nothing to do with the particular article that happens to be manufactured under that work order. If there were a fluctuation in the purchase price of material, or another kind of material were used in order to clear away a surplus on hand, or even if the right kind of material were of poor stock so that excessive scrap and defective product were produced, it is a matter of chance that the variation falls in one lot or into the cost of one product, rather than in other lots or other products. The unit costs of the products which were made varied (and those of other products which were not made were spared the variation) principally because these general conditions obtained at the time. Or, unit labor costs may have varied in a given period, not because certain products were made under certain job orders at the time, but primarily because of unusual or temporary conditions affecting either the pay of the workers or their output. Or, again, the burden in unit costs may have varied, not in any close degree because of the nature of the products which were made at the time, but because of a fluctuation in indirect expenses, or in the rate of activity in the factory, that is to say, the percentage of capacity utilized.

When such variations from general causes are introduced into the job costs of products made during their continuance, artificial variations in unit costs are produced. They make it appear as if the cost of making these products had varied, which is true only in the remotest sense but by implication is attributed to effectiveness in manufacturing the products affected.

Such fluctuations in unit costs may become so disturbing that the individual results must be more or less disregarded, and an average must be found which can be used for cost purposes. The disparity in unit costs of the same products made repeatedly can be, and fre-

quently is, marked and unreasonable. For example, a transcript of a record on the manufacture of a part of a machine product shows the following experience in the manufacture of that part:

PART NO. X1234

Date	*No. of piece*	*Order No.*	*Cost each*
On hand	24	Average	$ .76
Jun. 1926	3	600	.67
Jul. "	2	621	.86
Jul. "	1	622	.81
Jul. "	1	639	1.88
Total	31	Average	$ .80
Nov. 1926	3	744	.85
Nov. "	1	742	.96
Nov. "	1	741	.83
Jan. 1927	3	756	.95
Jan. "	1	775	1.09
Jan. "	2	780	1.21
Feb. "	5	802	.81
Feb. "	1	820	1.24
Total	48	Average	$ .83
Mar. 1927	2	821	1.17
Mar. "	1	826	.63
Mar. "	4	840	1.38
Apr. "	6	855	.64
Apr. "	2	836	1.17
Total	63	Average	$ .85
Inventory	2	Average	.85
Jul. 1927	1	945	1.06
Jul. "	2	937	1.09
Total	5	Average	$ .99

Here much effort was expended to distribute, collect and recapitulate these unit costs under each work order on which part No. X1234 was made in these years. During the month of March, 1927,

four pieces were made at a cost of $1.38, while another single piece manufactured earlier in the same month cost only 63c, according to the record. This is illogical, because it is to be expected that the unit cost of the four pieces would be considerably less than that of one piece, if only because of the saving in machine set-up cost. In this instance, the unit cost of the four pieces, instead of being less than that for the single piece made on a previous order, is actually 2.2 times as great.

The record also indicates that during the year ended June, 1927, 63 pieces were manufactured under 17 different work orders, at an average cost of 85c per piece (including the opening inventory). This average cost of 85c is used for inventory and other costing purposes, although only two pieces remained on hand in the inventory at June 30th. It is fair to assume that they were probably the last two pieces manufactured, under order No. 836. They actually cost, according to the record, $1.17.

In July, the unit cost is recorded at $1.06 and then at $1.09. The effect of the average cost of 85c on the two pieces standing in the inventory at the beginning is carried forward into the ensuing average cost, whereas in actuality the first two pieces have since been used. This condition will arise when costs are averaged over a period of six months or one year, as is frequently done.

This transcript was taken from a record in actual practice and was the first card picked at random from the file. Similar inconsistencies may be expected to appear on cards for many other parts and, when it is borne in mind that the variety of such parts may range from a few hundred or thousand to fifty and sixty thousand parts, the extent of the disadvantage can readily be seen to be substantial.

A correct measure of accomplishment at a given time can only be made by comparison with a standard or expected level of performance. Judgment based upon comparison with an average or with a past performance is inconclusive. Performance in a specific instance obviously will hardly parallel an average which is composed of many fluctuating results of previous attempts. Even a comparison of performance in a specific instance with another prior specific instance is at best only indicative, unless all the attendant conditions were identical, which will rarely occur. The futility of basing

comparisons as to costs upon past costs is evident from the very fluctuations which occur in those costs. It is a certainty that the next cost will not be the same as any slected past cost or an average of a string of them, except by coincidence. Therefore, it is a decided disadvantage to be without definitely fixed and reasonably stable standards for comparison and to be under the necessity of reading their equivalent into any figures which are being scrutinized.

The difficulty of making comparisons without standards, therefore, is a real handicap and is not confined to unit costs compiled under job orders merely, but extends throughout all accounting reports and presentation of the figures under any system in which such standards are not set up as an integral part of the entire scheme. Consider for a moment the mental processes which must be gone through by an executive on reading any report lacking standards—let us say, a simple payroll analysis. Presumably the report contains figures as to the payroll for the current period in each department of the factory, sub-divided perhaps betwen direct labor and indirect labor, with percentages. For comparison, similar payroll figures are given for another period, which may be the preceding month, or a corresponding month in the preceding season or year. The figures as presented can not be compared directly, even though set down in parallel form and for parallel periods.

In a number of instances it will be necessary to make reservations mentally for conditions existing internally in the current period, which were unusual or not present during the preceding period. Conversely, there may be other instances when conditions internally in the preceding period differed from those prevailing in the current period. Further, it may be necessary to make still other mental reservations for any disparity in external conditions between the two periods. Not until this reasoning process has been gone through, is it possible to reach a true judgment upon the figures shown in the payroll report. The process is equivalent to introducing standards for comparison, i.e., reading standards into the figures. It is a burdensome task, and one for which executives in busy times lack the leisure. This may be one reason for the complaint that executives do not make use of accounting reports compiled at the expenditure of much time and effort. The vital deficiencies are the omission of

standards and of a preliminary interpretation of results based on them.

Recognition of these disadvantages and the endeavor to overcome them have led to noteworthy progress through the use of standard costs. The accounting plan when standard costs are in use is quite different from job costs, although manufacturing work orders may be retained for shop routing and identification. Costs, however, are not collected under work orders.

Description of the Standard-Cost Plan

The initial step in the installation of standard-cost-accounting procedure is the establishment of files of basic prices or rates for materials, labor and burden. The file of basic standard material rates is a schedule of itemized prices for all the various kinds, grades and sizes of material used. A separate price embodying the proper differential is set for each size and grade of each kind. The standard prices are specific prices and not averages. Examples of parts of such a file are shown in Figures 1, 2 and 3, following:

Figure 1

STANDARD MATERIAL PRICES

Electrical products

Account number	*Material*	*Standard price*
R-30	Contract copper	$ .10
R-35	Tin	.38
R-35	Tin on wire	.50
R-35	Lead	.05
R-40	Salt	.007
R-51	Hydro-carbon M. R. hard	.007
R-51	Litharge	.05
R-51	Rubber makers grease	.03
R-51	Factice No. 1-H milled brown granulated	.09
R-51	Fine up-river Para	.25
R-51	Para regular rubber	.18
R-51	Light thin brown Para sheets	.17
R-51	Para, washed and dry	.24
R-51	No. 20 Paris whiting	.007

Account number	*Material*	*Standard price*
R-51	Sulphur	$ .01
R-51	Zinc oxide	.05
R-51	Whiting	.004
R-51	Grade C shoddy	.08
R-51	Grade D shoddy	.05
R-51	No. 1454 shoddy	.06
R-51	No. 2865 shoddy	.06
R-51	No. 2880 shoddy	.06
R-51	No. 2961 shoddy	.06
R-51	No. 2972 shoddy	.06
R-51	No. 2984 shoddy	.06
R-51	No. 2995 shoddy	.06
R-51	Soap chips	.08
R-51	Catalpc	.01
R-51	Captax	.42
R-51	Red zinc	.06
R-65	40-2-1 glazed cotton	.46
R-65	36-2-1 glazed cotton	.45
R-65	30-2-1 glazed cotton	.40
R-65	24-2-1 glazed cotton	.38
R-65	4-2-1 braider cotton	.20
R-65	4-3-1 braider cotton	.20
R-65	4-4-1 braider cotton	.20
R-65	6-1-1 braider cotton	.21
R-65	6-2-1 braider cotton	.21
R-65	6-4-1 braider cotton	.21
R-65	6-6-1 braider cotton	.21
R-65	8-1-1 braider cotton	.22
R-65	8-9-1 braider cotton	.21

(All prices per pound except where otherwise noted.)

FIGURE 2

STANDARD MATERIAL PRICES

Textile converting

Ducks

Style	*Width (inches)*	*Finish*	*Price per yard* *Grey*	*Dyed*
41-2	51½	Grey	$ .16	—
41-3	50	Dyed	—	.17

Ducks

Style	*Width (inches)*	*Finish*	*Price per yard* *Grey*	*Dyed*
43-2	52	Grey	$ .17	—
43-3	50	Dyed	—	.18
45-0	38½	Grey	.14	—
45-1	46½	"	.17	—
45-2	45½	Dyed	—	.21
45-3	51½	Grey	.18	—
45-4	51	Dyed	—	.22
45-5	56½	Grey	.20	—
45-6	56½	Dyed	—	.25
45-7	61	Grey	.22	—
45-8	60	Dyed	—	.29
45-9	74	Grey	.26	—
48-0	52	"	.26	—
50-0	42	"	.28	—
50-1	50	"	.33	—
50-2	54	"	.36	—
50-3	60	"	.40	—
50-4	66	"	.45	—
50-5	72	"	.51	—
52-0	50	"	.28	—
52-1	54	"	.31	—
52-2	54	Dyed	—	.36
52-3	60	Grey	.34	—
52-4	66	"	.39	—
52-5	72	"	.44	—
52-6	84	"	.62	—
52-7	96	"	.60	—
54-1	54	"	.22	—
54-2	52	Dyed	—	.26
55-1	51½	Grey	.21	—
55-2	51½	Dyed	—	.25
58-1	86	Grey	.40	—
58-2	94	"	.42	—
60-1	51½	Dyed	—	.24
61-1	36	Grey	.31	—

FIGURE 3

STANDARD MATERIAL PRICES

Machine shop

Item		Standard Cost
	Round mild steel:	
5/16"	Rd. mild steel	$ .032
3/8"	Half rd. mild	.042
3/8"	Rd.	.029
1/2"	Rd. mild steel	.028
5/8"	"	.027
3/4"	"	.027
7/8"	"	.026
1 "	"	.026
1 1/8"	"	.026
1 1/4"	"	.026
1 3/8"	"	.026
1 1/2"	"	.026
1 5/8"	"	.026
1 3/4"	"	.026
1 7/8"	"	.026
2 "	"	.026
2 1/4"	"	.026
2 3/8"	"	.026
2 5/8"	"	.026
2 3/4"	"	.026
2 7/8"	"	.026
3 "	"	.026
3 1/4"	"	.026
3 3/8"	"	.027
3 3/4"	"	.027
4 "	"	.027
4 1/4"	"	.027
4 1/2"	"	.027
5 "	"	.028
5 1/4"	"	.029
5 1/2"	"	.030
6 "	"	.031
6 1/2"	"	.030
7 "	"	.032
8 "	"	.032
8 1/2"	"	.039
	Round mild steel:	
	Rd. mild steel	$ .036
	Mild steel square:	
3/8"	Sq. mild steel	.030
1 1/2"	"	.026
4 1/4"	Forging steel	.072
	No. 4 ann. steel:	
9/16" x 1 1/2"	No. 4	.088
9/16" x 1 3/4"	"	.088
5/8" x 3 1/2"	"	.094
5/8" x 3 1/2"	"	.094
1 1/4" Hex	"	.096
	Spring steel:	
5/8" – 16"	Ga. hardened spring steel	.192

The file of basic standard labor rates is an itemized schedule of operations containing the equivalent of piece-work rates. When wages are paid under another method, labor costs are converted into a standard rate per piece. The arrangement of the file of standard labor rates will vary with the circumstances and requirements; an example is shown in Fig. 4, pages 13 and 14. Frequently burden rates are compiled on the same schedules because they also run according to operations, as in Fig. 4a, opposite.

Standard burden rates are set by means of a budget of the manufacturing expenses expected to obtain when operating at a given level of capacity, which is termed "normal capacity". The budget includes estimates of the corresponding hours of operation in machine hours or man hours or their equivalent (Typical pages of such a budget are shown in charts X, XI, Appendix). Thus standard burden rates for the respective operations are derived, and they can then be converted into standard burden rates per piece, as is done with direct labor. Examples of such basic rates are shown in Figures 5 and 6, pages 14 and 16.

After the basic standard rates for materials, labor and burden have been established, files of standard costs are prepared for each product or part manufactured. Upon these the materials, labor and burden are assembled in the right proportions. The result is a record

bringing together, in terms of standard dollars, the elements of cost going into each product. The arrangement of this record again will vary with the individual requirements. Some typical standard cost records are shown in chart I, Appendix.

Distinction Between Budgets and Standard Costs

The data so compiled in the files of standard rates and standard costs are used thereafter for many different purposes, such as budgeting, planning production, controlling manufacturing, estimating costs, costing sales and analyzing profit variations. For instance, in budgeting sales and profits, the standard cost of goods expected to be sold is useful for introducing the right proportions as to products and profit margins, as well as later for separating the variations between actual and expected results. For planning, standard hours and standard quantities are useful in obtaining totals of hours by departments or machine groups and of quantities by kinds of material, so as to prepare for regular operation. For controlling production, hours and quantities are again useful as a guide and an incentive in the multitude of detailed operations of manufacturing. For estimating and costing, the usefulness of the basic standards is apparent.

There is a distinction between budgets and standard costs which is not always clearly understood. The terms are not synonymous. A budget may be used without embodying standard costs. Standard costs are not necessarily budgeted or expected costs. The only instance in which the terms are synonymous is that wherein budgeted burden rates are used for computing standard burden costs. For that purpose the burden budget is a necessary preliminary calculation.

It is usually found when standard costs are used that budgets and budgetary methods will also be adopted, because both procedures have in common the object of better management through planning toward definite ends, regulating performance according to definite expectations, and recognizing effectiveness in accomplishment. Budgets are the logical accompaniment of standard costs.

Figure 4

STANDARD DIRECT LABOR RATES

(For conversion into standard labor costs by applying standard production per hour)

Machine shop

Machine or operation	*Department*	*Standard Direct Labor rate per hour*
Plane	81-0	$ .51
	92-1	.48
	71-2	.44
Shaper	81-0	.32
Mill	81-0	.48
	82-3	.49
	86-4	.40
	92-1	.48
	71-2	.44
Spline mill	92-1	.44
Upright	83-5	.40
	87-6	.40
	71-2	.44
Radial drills	83-5	.44
	87-6	.44
Mul. spindle drills 4	83-5	.44
	87-6	.40
Movable platform drills	83-5	.50
Horizontal bor. and drill mach.	83-5	.44
Boring mills	83-5	.48
Boring bar	83-5	.54
Layout	83-5	.60
Engine lathe (rough over .002)	86-4	.44
	88-7	.44
	92-1	.40
	71-2	.48
Engine lathe (finish .002 or less)	92-1	.48
	71-2	.48
Turret lathes	86-4	.48
	92-1	.48
	71-2	.48
Roll turning	85-0	.48
Internal grinders	84-8	.51

Machine or operation	*Department*	*Standard Direct Labor rate per hour*
Surface grinders	81-0	$ .40
	86-4	.40
	92-1	.48
	71-2	.40
Knife grinders—Rough	73-9	.36
" —Finish	71-2	.48
	72-9	.44
	73-9	64
Gear hobber	76-4	.48
Gear shaper	76-4	.50
Hand screw machine	92-1	.46
Auto screw machine	92-1	.56
Thread mills	92-1	.48
Bench	87-6	.36
	88-7	.36
	92-1	.44
	78-2	.44
Blacksmith	91-7	.46
Blacksmith's helpers	91-7	.34
Drum floor misc.	88-8	.44
Cover drums	88-7	.48
Tinsmith	89-8	.44
Balancing	71-2	.48
Heat treating	74-9	.56
Erecting	61-6	.46
	62-3	.46

FIGURE 5

NORMAL EXPENSE RATES

Foundry and machine shop

Dept. No.	*Name*	*Machine group*	*Machine numbers*	*Normal expense rates per man hour*	*per machine hour*
54	Coremaking	—	—	$ .54	—
55	Molding	—	—	.61	—
56	Cleaning castings	—	—	.36	—

REDUCTION RATIO 15:1

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2.0 mm

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1.5 mm

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PM-MGP 13"x18"
METRIC GENERAL PURPOSE TARGET
PHOTOGRAPHIC

200 mm

150 mm

100 mm

1.0

1.1

1.25

1.4

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1.8

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PRECISION℠ RESOLUTION TARGETS

Century

A&P

1303 Geneva Avenue
St. Paul, MN 55119

4.5 mm

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FIGURE 4-a

STANDARD-COST RATE SHEET

Date _____ Department _____ Operation _____

DESCRIPTION OF PRODUCT				MACHINE				THEORETICAL PRODUCTION				SPINDLES			STANDARD PRODUCTION		LABOR RATES PAID (Not including 10% Premium)					STANDARD COST RATES						
																						DIRECT LABOR (Including 10% premium)			MANUFACTURING EXPENSE			
SIZE		Put up	Special features	TYPE	Spindles per machine	Machine number	R.P.M. of		Feet per minute		Per spindle hour	Per operator	Per helper	Per man	Per man hour	Per spindle hour	To operator	To helper	Total	Unit paid for	Rate per	Per man hour	Per spindle hour	Per	Per man hour	Per spindle hour	Per	SIZE
Number	Drawn from																										

REDUCTION

RATIO

12:1

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PM-MGP 13″x18″
METRIC GENERAL PURPOSE TARGET
PHOTOGRAPHIC

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PRECISION℠ RESOLUTION TARGETS

Century

A&P

1303 Geneva Avenue
St. Paul, MN 55119

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abcdefghijklmnopqrstuvwxyz
1234567890

4.5 mm

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abcdefghijklmnopqrstuvwxyz1234567890

3.5 mm

FIGURE 4-a

STANDARD-COST RATE SHEET

Date | Department | Operation

DESCRIPTION OF PRODUCT				MACHINE			THEORETICAL PRODUCTION					SPINDLES			STANDARD PRODUCTION		LABOR RATES PAID (Not including 10% Premium)					
SIZE																						
Number	Drawn from	Put up	Special features	TYPE	Spindles per machine	Machine number	R.P.M. of		Feet per minute		Per spindle hour	Per operator	Per helper	* Per man	Per man hour	Per spindle hour	To operator	To helper	Total	Unit paid for	Rate per	

FIGURE 4-a

STANDARD-COST RATE SHEET

Operation

...HINE		THEORETICAL PRODUCTION					SPINDLES			STANDARD PRODUCTION		LABOR RATES PAID (Not including 10% Premium)					STANDARD COST RATES						SIZE
																	DIRECT LABOR (Including 10% premium)			MANUFACTURING EXPENSE			
...dles ...hine	Machine number	R.P.M. of		Feet per minute		Per spindle hour	Per operator	Per helper	* Per man	Per man hour	Per spindle hour	To operator	To helper	Total	Unit paid for	Rate per	Per man hour	Per spindle hour	Per	Per man hour	Per spindle hour	Per	

Dept. No.	Name	Machine group	Machine numbers	Normal expense rates per man hour	Normal expense rates per machine hour
62	Erecting—shop No. 1	—	—	$ .44	—
63	Erecting—shop No. 2	—	—	.48	—
66	Testing	—	—	.86	—
67	Repair parts assemblies	—	—	.51	—
72	Heads and bits	1	291-934-935-802-803-412-872-9011-2371-488-489-490-491-492-5501-5411-5416-5417-1811-1812-1813-1814	—	$ .34
	"	2	1571-1572-658	—	.44
	"	3	5071-5073-9471	—	.49
	"	4	162-7331-528	—	.47
	"	5	786-248	—	.39
	"	6	8601-1231-8471	—	.88
	"	7	3371	—	.41
	"	8	461-632-4341-6651-8651-7231	—	.30
	"	9	942-723-857-228-192	—	.45
	"	10	769-7011	—	.45
	"	11	7901-646-824-308-9031	—	.33
	"	12	532-9811-9531-6031	—	.33
	"	13	Bench work 4	.38	—
73	Thin knives	1	176	—	2.32
	"	2	2031	—	1.52
	"	3	Bench work	2.22	—
74	Turning heads and knives	—	—	.34	—
82	Planers	1	858-704-793-736-8931-214-1041-5051	—	.42
	"	2	92	—	.49
	"	3	851-621-958-707-896	—	.52
	"	4	514-177-13-531-893-314-631-5931-731	—	.47
	"	5	1501	—	.73
	"	6	1502	—	.82

FIGURE 6

NORMAL EXPENSE RATES

Printing

Dept. No.	Group No.		Normal expense rates per man hour	Normal expense rates per machine hour
		Bindery department		
62	330	Stock cutters 6201 to 6204-6216-6208 to 6209	—	$ .93
63	340	Small machines 6221 6261 6245-6246 6210-6212-6214 6232 (and 3 sealing machines)	—	.64
64	350	Continuous stitchers 6441 to 6452 inclusive	—	2.15
65	360	East stitchers 6515 to 6554 inclusive	—	2.86
		Folders:		
66	371	6610 to 6641 inclusive and 6653	—	.69
66	372	6612 and 6662	—	.72
66	737	6632-6642-6652-6672	—	1.11
66	374	6604 to 6605 inclusive and 6615	—	1.59
66	375	6616-6626-6637-6618-6628-6638	—	.53
66	376	6603	—	1.51
66	377	6619-6629	—	2.55
		Gathering machines:		
67	381	6761-6742-6772	—	3.49
67	382	6604	—	5.85
67	385	6634	—	8.36
68	391	Covering machines 6871-6881-6891	—	2.82
68	392	Patent binding machines 6818-6838	—	8.10
69	400	Handwork	$ .25	—
70	410	Mailing	.27	—
		Trimmers:		
74	451	Rowe 3 knives 7410 to 7460	—	2.99
74	452	Safety 1 knife 7401 to 7403	—	.55
74	453	Sheridan 1 knife 7470	—	.65
74	454	Seybold rotary table 3 knife 7454	—	1.04
75	460	Combination gatherers and covering machines 7503-7513-7523-7524	—	6.08
		Packing department		
76	470	Packing	.36	—

DESCRIPTION OF THE STANDARD-COST PLAN (*Continued*)

As previously stated, costs are not assembled under work orders. The actual cost of materials used is set up in accounts for work in process according to material classes or according to processes, if the materials become merged. Labor is not distributed on cost sheets between jobs according to operations, but the actual payroll by departments is set up in work-in-process accounts. If the departments are large and vary in the character of labor employed, the totals may be sub-divided into appropriate production centers. The actual expenditures and accruals for burden are charged to departmental expense accounts, to which suitable credits for the amount of burden absorbed in cost of production by means of normal burden rates are made subsequently.

Against the actual cost of material, labor and burden thus classified and set up the corresponding standard costs are entered. The amounts of the standard costs are obtained by pricing production at the previously established basic standard unit costs. A relationship is immediately established between the actual cost of material, labor and burden at normal rates, and the standard costs for the same items. The latter represents, let it be assumed for the time being, what the actual cost would have been had no variations occurred. (The standard cost may not represent the expected cost but merely a fixed basis of calculation. In this case expected cost is at some ratio to standard other than 100, and the variation is betwen the actual ratio and the expected ratio. This is brought out later.) This relationship can be expressed by a ratio of actual to standard costs, and the ratio becomes (1) the measure of performance, (2) a correction factor to be applied to standard costs in making cost calculations, (3) an index character for comparison with other variations in terms of common denomination, and (4) a barometric symbol indicating the rate and direction of the trend.

The disadvantages of the job-cost plan, which have been cited, can be overcome by means of this procedure. The length of time required to obtain the information that variations are occurring can be substantially reduced. When standard costs have been prepared in advance, it is not necessary to wait until a lot or job has been fin-

ished or a "cut-off point" has been established in order to ascertain the trend. It can be disclosed as soon as work is begun and can continue to be disclosed as the work progresses, because a standard, as the basis for comparison, exists for every activity. Therefore, as soon as the activity begins and the actual cost of it is known, the standard cost can be set beside it. No delay need ensue pending the summarization of lot costs, and data which are useful for control purposes can be provided in various ways as promptly as desired—daily, weekly, semi-monthly and monthly.

The work of analysis goes on currently with the assembly of the figures and does not await the completion of production orders. The accounting routine is so planned that the desired operating statistics are rendered available by the manner in which the figures are put together and on the basis of the standards which are carried throughout all the accounting. As a result, reports contain figures already analyzed to the point of singling out and showing prominently the variations from the expected in performance, together with a preliminary interpretation of the major causes or conditions contributing to the variations. The standards for comparison, which would have to be read into a report that is merely a tabulation of the end results, in order to judge correctly the effectiveness of those results, are already there. The exceptional results are indicated, so that the executive officer's burden of going through the preliminary analytical process is removed. The salient information is immediately available for reasoning, investigation and action.

The artificiality of variations is to a large extent eliminated, because the changes and trends are brought out according to their natural and fundamental classification. That is to say, material variations are expressed by material classes or by processes and are sub-divided into major contributing influences, such as variations in purchase prices, in spoilage, in scrap, in shrinkage, etc. Variations in labor costs are shown by occupational or departmental groups, instead of by job orders, and are segregated according to principal causes, such as man effectivenesness, spoiled work and changes in pay rates. Burden is classified into that absorbed in costs of production and that not absorbed. The former can be separated into the variations due to spoilage of product and to changes in machine effectiveness.

The latter can be separated into the variation which arises from spending more or less than expected and that which arises from absorbing more or less than expected as the reflection of factory activity.

It will be apparent that there is here a complete reversal of objectives. Whereas, under the job-cost plan, the aim is to find the unit cost and then to analyze it to find the variations which took place, under the standard-cost plan the primary object is to find the variations, which then can be applied to find the effect of them in actual costs. In the meantime, knowledge as to the variations is useful in many managerial ways, the importance of which is paramount to cost finding alone.

Fluctuations are sharply brought out, so that those which are unfavorable can be curtailed if possible and those which are favorable may be extended. Substantial benefit is to be gained in preventing or reducing losses, by furnishing to the factory, as part of the manufacturing specifications, selected practical data as to the standard or expected performance. The savings which can be made by minimizing preventable losses through such means are often surprisingly large in the aggregate.

The standard-cost plan is also more economical of clerical effort and expense than the job-cost plan, assuming equal competence in carrying them out, not only in terms of dollars, but measurably more in terms of the value of the information obtained. There is to be considered, of course, the establishment of the fundamental standard-cost files which are necessary under the standard-cost plan. This, however, is an initial expense, not a recurring one, and it often happens that the knowledge gained in the course of the undertaking in itself almost warrants the establishment of such a file.

In addition to providing means for overcoming the disadvantages mentioned, the standard-cost plan has other merits. To appreciate this, it must be recognized that in industry all the factors expressed by accounting figures are moving factors—that is to say, the figures relate to activities which are continually fluctuating. All these moving factors are relative, not absolute. Many are components of others, and all of them are parts of equations in proportion. So the accounting plan, if it is to be adequate for the requirements of in-

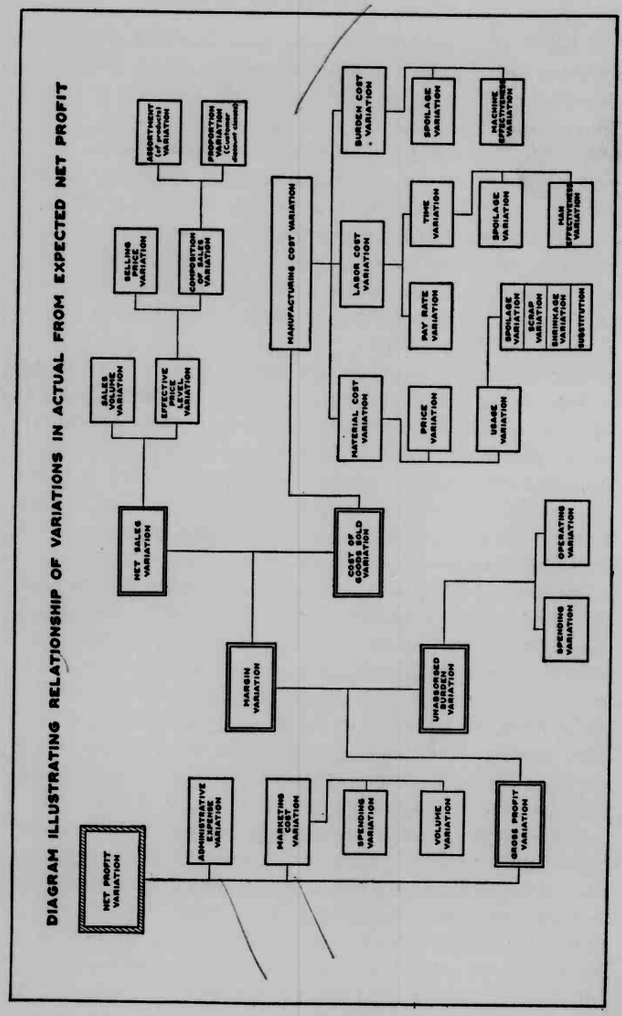


FIGURE 7

dustry today, must provide means for indicating the rate and direction of change in each moving factor. It must provide for indicating the relationships between the factors and whether or not the rate and direction of the changes are in the correct proportion. It must also be recognized that, at least for purposes of business control, the direction of inquiry must be "whither hence", rather than "how came we here". Therefore the adequate accounting plan must provide means for readily projecting experience to indicate trend and for predicting, within the bounds of human fallibility, the probable results of certain courses of action.

The ratios obtained under the standard-cost plan, which are the measures of performance, are at the same time almost ideally suited to meet these requirements. Their number and character are determined by the demands for their use in each case. Moreover, their usefulness is not confined to the province of manufacturing and manufacturing costs alone, but extends further into the analysis of sales and variations in net profits. (These uses are the subject of subsequent chapters; it will suffice at this point merely to refer to them, so that it shall be understood the ratios are a cardinal feature of the standard-cost plan and have many applications.) That net profits must be affected by any and all variations is self-evident. Their inter-relationship is perhaps best shown in diagram form (Fig. 7 opposite). It will be seen that some variations have to do with manufacturing and others with sales. They may be complementary or supplementary, and they converge or combine to bring about the net result, namely, the difference between the net profit expected to be made and that actually realized. Standard costs serve as the basis for computing the amount of each variation, and account in total for this difference.

The cost ratios can be used also as correction factors of the basic standard costs, to be applied when making cost calculations of various kinds, without re-tabulating all the detail of materials, labor and burden going into each product. Three such calculations of costs, differing according to purpose for which the calculation is made, are usually required, namely: (1) current costs, (2) average costs and (3) replacement costs. Current cost is the actual cost of production during a given recent period, usually the last month. For this, the

cost ratios which develop during the month can be used to adjust standard costs to the level of actual costs in that month. Average costs represent the actual costs after taking into account all variations, both favorable and unfavorable, over a period of time, such as a quarter or moving six months. To compute average cost, the standard cost will be adjusted by cost ratios representing the experience as to variations over the designated period. A replacement cost is the calculation of the expenditure considered necessary to replace a product, that is, to make it next month. Literally, it is an estimate rather than a cost. To make the calculation, suitable ratios are selected for materials to reflect the market or expected material price, which are then modified from experience as to usage. Ratios for labor and burden are also selected, but they are based on judgment, with consideration of experience and expectations.

All three calculations can be made on the basis of the established standard costs, using appropriate ratios. There is a considerable saving in this procedure, most notable in the case of products assembled from a great many parts, some individual and others interchangeable. Especially when it comes to the calculation of replacement costs, it would be necessary under the job-cost plan to refigure completely the costs of parts, sub-assemblies and final assemblies. Under the standard-cost plan, it is possible to make the revision in totals, by means of a relatively few classified ratios applied to the summarized standard costs of the final assembly. This facility is often a great advantage.

For these reasons, the standard-cost plan is in every way superior to the job-cost plan and should eventually entirely replace it for manufacturing industries. Of course, there will always be occasions when it will be necessary to compile a job cost, such as in the case of cost-plus contracts. For industries other than manufacturing, such as building construction, engineering projects and the like, it will also be necessary to keep track of costs by jobs. Here, however, the situation is somewhat different from that of manufacturing, for each project is effectually a separate enterprise. Standard-cost principles can be and are used, however, to a certain extent. But for manufacturing businesses, the standard-cost plan is the best yet devised to meet modern requirements.

Universal Application of Standard Costs

A supposition which is often found in the minds of those who have not had experience in the use of standard costs is that such costs are unsuitable for the manufacture of special or irregular goods made to order. This is due, no doubt, to the interpretation of the word "standard" as applicable only to articles which are standardized and manufactured in quantities. It is true, on the contrary, that standard costs are more useful and beneficial in the manufacture of specialties than when the articles are all of stock pattern. The conditions then are more complicated and the problems of control are more difficult to solve. Special products differ from each other in fact only in the style, ingredients and dimensions of the articles made; the activities of making them are mainly similar. The question is often raised how it can be possible to apply standard costs in a manufacturing business where no two orders received are alike, no two products are the same, and no product will be made in exactly the same way a second time. It must be remembered that in such a business the respective end products, though each may differ from all others, can be classified as to their elements. All the different products are made in the one factory upon existing equipment, out of the same or allied materials and by the same employees. They differ only in the specifications as to how these factors are to be utilized and assembled. Inasmuch as the standard costs are basic specifications, it is feasible to arrange them so that they will fit any product. It is merely a matter of extending the manufacturing specifications at existing basic standard rates for the proper materials, labor and burden. The greater the variety or complexity of the products, the greater the benefits to be derived through the use of standard costs as the basis for measuring and controlling operations.

Standard costs have been applied and used successfully in many different industries, such as:

Agricultural implements
Airplanes
Bakeries
Bleaching and dyeing
Boxes (wood) (paper)
Brick and clay
Canning, packing
Carpets, rugs
Confectionery
Cotton mills
Die casting
Enameling

Fibre products
Food products
Foundries
Furniture
Hardware
Ink manufacture
Jewelry
Jute mills
Linoleum
Machine shops
Machine tools
Milling, flour and cereals
Printing, publishing
Radios
Rubber
Silk mills
Smelting
Tobacco products
Wire, cable
Woodworking
Woolen mills

This list is not intended to be comprehensive but merely indicative of the universal application of this method of industrial accounting.

CHAPTER II

DESCRIPTION OF THE STANDARD-COST PLAN

It will be helpful in obtaining a clear understanding of the main principles of cost analysis by means of standard costs to trace some hypothetical transactions through a simple set of figures. Any figures will do, so long as they are simple, in order that the thread of thought on the underlying theory shall not be lost in a maze of complicated arithmetic. Chart II, Appendix, is arranged to furnish a specific example. The chart is removable so that the tables may be referred to while perusing the text describing them. Key numbers which are given in the text in brackets, relate to the items in the tables.

Twenty items of elementary operating data are given in Tables I, II, III, and IV. On the basis of these, 15 significant operating ratios are obtained, shown in Table V, together with seven amounts of cost changes, afforded by analysis of variations in actual from standard costs disclosed by the figures.

Table I shows the basic data on labor and burden required. It may be assumed that these apply to a department of a factory or a subdivision of a department regarded as a production center. It is estimated that when the department is operated at normal capacity, the time of employees will aggregate 1,500 hours for the period (1), while the time of machines, that is the machine hours run, will be 1,000 (2). For the sake of simplicity, let us assume that all employees work on machines; in the majority of cases each employee works on one machine, but there are some who run more than one machine. Also, for the sake of simplicity, burden is to be applied by means of machine-hour rates.

Although in actual practice the conditions may not be so simple, and there will be a great variety of cases for which suitable methods

must be devised, the example will serve to bring out the principles employed. The necessary modifications to meet the particular problems involved can readily be designed, once the general principles are understood. After all is considered, the calculations are no more abstruse under the standard-cost plan than under any other, being plain arithmetic; the only difference is that they are calculations in proportion instead of in addition and subtraction.

A budget of the direct labor and burden relevant to operations at the normal capacity contains $1,200 for labor and $1,800 for burden (3, 4). Normal capacity, therefore, contemplates production at $3,000 (5) and an average composition of products requiring 40% labor and 60% burden.

A standard-cost file has been prepared in which the standard costs of labor, burden and material have been set down in detail for each article manufactured. These standard costs are synchronized with the basic data, so that, theoretically, if the quantity of articles in a given assortment that can be produced at normal capacity were extended at the respective basic standard costs, the total would agree with the budgeted capacity, $3,000.

Table II contains figures on the standard cost of actual production during a corresponding period. These figures are obtained by pricing and extending, at their respective basic standard costs, the quantities of articles actually made. These figures show that production on the whole as to labor and burden is at 70% of capacity (8A). The nature of the articles produced, however, has been such as to change the proportion between labor and burden in the aggregate from the contemplated percentages of 40% and 60% to 36% and 64% (6, 7). This brings about a ratio of production to budget of 63 for labor and 74.7 for burden (6A, 7A). Had the articles actually produced been in the same assortment as the average contemplated in the budget, the labor ratio and the burden ratio to the budget would have been 70. As they were not, it is evident the assortment of products made has differed.

Table III contains data on actual costs and operations. The payroll for direct labor is $1,058.40, which is 88.2% of the budget (10A), and 140% of the standard cost of production (10B). The payroll is at a level of 88.2 during the period when the standard labor cost of production is at a level of 63 (6A); therefore, actual labor cost is above standard for the articles produced (88.2÷63=140).

The actual burden is $1,557, which is 86.5% of the budget at capacity (11A), or 115.8% of the standard burden cost in production (11B). Burden expenditures stand at a level of 86.5, at the time when the equivalent at standard in actual production is at a level of 74.7 (7A).

The effect of the variations which have occurred is that the actual cost for labor and burden stands at a ratio of 124.5 for the entire production (12B).

Actual man hours reported on the payroll aggregate 1,260 (13). This is at a level of 84% of the budgeted capacity (13A). But the standard labor contained in production is at the level of 63% of this budget (6A). Evidently it cost 84 in time to produce what is worth 63, in terms of ratios, which indicates that time is one-third above standard (84÷63=133.3), i.e., man hours are at the ratio of 133.3 to standard man hours for current production (13B).

The actual machine hours run are reported at 770 (14), which is 77% of the budgeted capacity (14A). The standard burden in cost of production, however, (likewise introduced in the first instance on the basis of machine hours) comes to 74.7% of the budget (7A). Therefore, slightly more than standard machine time was required for current production. The machine-hour ratio to standard is 103.1 (14B) (77÷74.7=103.1).

Table IV shows that the actual cost of material used is $764.75, while the standard cost of it is $805.00 (15). The actual cost is below standard, showing a price ratio of 95 (16B). The material specified, in other words the material that should have been used for the articles currently produced, should have amounted, at standard cost, to $700 (17). Inasmuch as the standard cost of material actually used is $805 (15), an increase in usage is shown. A greater quantity of material was used (or some other material substituted) than is specified in the basic standard costs for the articles which were made. The usage ratio is 115 (18B).

When the actual cost of the material used, $764.75 (15), is considered in relation to the standard cost of the material that should

have been used, a cost ratio of 109.3 actual to standard (19B) is obtained.

These elementary figures disclose that the actual cost of current production increased over standard, to the extent of $515.40 for labor and burden (9), and of $64.75 for material (20), a total increase of $580.15.

There are now at hand all the data necessary for the development of significant ratios on operating results and the preparation of a preliminary analysis to interpret these results and ascertain the major variations which took place. (Table IV.)

Man effectiveness is apparently below standard, inasmuch as man hours are one-third higher (13B). The man-effectiveness ratio is expressed as the reciprocal of the man-hour ratio, i.e., if man hours are one-third higher than standard, men are three-quarters effective (21A). This decline in man effectiveness has brought about a variation in labor cost of $252.00, which is computed by applying the percentage by which man hours exceeded standard to the standard labor cost of production (21B), on the theory that, had man hours not been excessive, more production would have been obtained for the period. In this example, if man hours had been at a ratio of 100—that is to say equal to standard—the standard labor content in actual production (6) would have been one-third greater, because more articles would have been produced.

The actual labor cost shown by the payroll is 140% of standard (10B), which indicates that a factor of variation other than time is present. (Had time been the only factor, the cost ratio would have been 133.3.) It is known that the other factor is the change in average hourly rates of pay which were earned in the period (see diagram Fig. 7, page 20). The labor cost ratio being higher than the man hour ratio indicates this other factor aggravated the man-effectiveness loss. In other words, pay rates must have been above standard, in order to result in increasing the ratio of 133.3 on time to the ratio 140 for both time and rates. By division it is found that pay rates for the period stand at a level of 105 (22A), meaning that, on the whole, average hourly earnings were 5% above standard. This change accounts for an increase of $50.40 (22B) in actual above standard costs.

The major reasons for the actual labor cost ratio of 140 are now seen to be a substantial decrease in man effectiveness and a small increase in pay rates. The ratio 140 (23A) is the result of man hours at 133.3 times pay rates at 105, and the total labor cost variation shows an increase of $302.40 (23B).

As to burden, machine effectiveness is slightly below standard, at 97 (26A), because the machine hours actually run stand at 103.1% of standard (14B). This is ascertained by comparing the ratio to the budget of machine hours run, namely 77 (14A), with the ratio of standard burden contained in production, which is 74.7% of the budget (7A). In other words, as it cost 77 in machine time to turn out production worth 74.7, machine effectiveness is 97.

The variation on this account is an increased cost of $42 (26B). This is computed by applying the percentage of increased machine time, 3.1%, to the standard burden cost of production, $1,344 (7), on the theory that, had machine time been equal to standard, so much more would have been contained in production: a greater quantity would have been turned out.

The actual burden cost shows that expenditures are at the rate of 86.5% of the budget (27A). They are less than the budget, which results in a favorable variation of $243 (27B). At the same time, the ratio of machine hours run, 77 (28A), indicates that a portion of available capacity remained unused. Hence the opportunity to absorb the budgeted burden did not exist to this extent, namely, 23% of the total. This circumstance caused an unfavorable variation of $414 (28B).

The combined effect of the reduction in spending and the reduction in operating is to bring about an unabsorbed burden of $171 (29B). The actual burden which is charged to cost of production corresponds to machine effectiveness. The burden cost, then, is 103.1 of standard, which amounts to $1,386. But the actual burden came to $1,557; the difference, which is unabsorbed, is $171.

It has already been found that the price level, at which the material used was purchased, is 95 (16B). The difference between the actual and the standard cost of it amounts to a saving of $40.25 (33B). The usage ratio shows an unfavorable variation, standing at 115 (18B). The standard cost of the material used is $805, where-

as the standard cost of the material which should have been used is $700. The difference, an increase of $105, represents at standard the variation through excess consumption (34B).

The sum of the labor, burden and material variations thus broken down will agree with the difference between the total actual cost and the total standard cost, accounting in full for it (36). Further analyses are possible, and will be discussed in subsequent chapters, where there will be consideration of such matters as spoiled work, scrap, shrinkage, etc., also, the procedure for expressing the variations between actual and expected results when the standard costs do not represent the expected results but represent rather a constant basis of measurement. For the present purpose of bringing out the main principles involved, these matters need not be taken up.

The ratios which have been described serve as operating signals or index characters, as well as the means of calculation. They can be combined in other ways, for other useful purposes. For instance, as to burden cost, an expense index can be set up. One way for doing this is divide the spending rate by the rate of capacity used. The quotient will yield a ratio which is the measure of spending in proportion to running (30A). If this can be kept at 100, there will be no unabsorbed burden; if it can be brought to less than 100, there will be a corresponding over-absorption of burden. The expense index is a useful barometer in the endeavor to control indirect expenses in times of fluctuating operation.

The rate of production can be expressed by the ratio of standard burden in cost of production to budgeted burden at capacity. In the example, this is 74.7 (31A). It indicates the relation of activity to capacity, and it can be used when obtained for all departments of a factory, as a barometer upon work in process. If this ratio, for a certain department, is notably out of line with similar ratios for other departments, assuming balanced facilities, it is evidence that the first named department is producing at a rate which is out of proportion with the remaining departments. Therefore, if the first named ratio is high, it means that work in process is being piled up; if it is low, it means that the contribution of the department concerned to the production of the plant as a whole is lagging behind.

Ratios of man effectiveness and machine effectiveness have already been ascertained separately. It may be desirable to obtain a similar ratio upon the effectiveness of the department as a whole, taking both man effectiveness and machine effectiveness together. This can be done by finding the relation between the standard cost of production under actual conditions and the corresponding standard cost of production had both man effectiveness and machine effectiveness been 100 (32A). In the example, if man effectiveness had been 100, standard labor cost of production would have been $1,008. If machine effectiveness had been 100, standard burden cost of production would have been $1,386. Together, these would have come to $2,394. They were $2,100. The over-all effectiveness for the department as to labor and burden, therefore, is 87.7, which is the ratio between standard labor and burden for standard time and standard labor and burden for actual time.

Another combination which is possible between man-effectiveness and machine-effectiveness ratios will be useful frequently. This ratio might be called the machine-labor-effectiveness ratio and is found by comparing machine effectiveness with man effectiveness. If the activities are in proportion, even though they may be out of line in regard to standard, the machine-labor-effectiveness ratio will be 100. If the man-effectiveness ratio is less than the machine-effectiveness ratio, the machine-labor effectiveness will be less than 100. In the present example, it is 77.3 (25A), indicating that, although machine effectiveness is down a little, relatively too much man power was used; that is to say, the employees running more than one machine ran too few of them.

Another labor ratio sometimes useful is one expressing the relation of pay rates to man effectiveness. In theory, at least, it is equitable that the rate of pay should go down commensurately with man effectiveness, so that the relation between the two shall remain at 100. In practice, this will not usually occur. So a ratio indicating the true relationship may be a gauge upon the soundness of the wage-payment method. In the broadest sense, the labor-cost ratio is the relation of the pay to man effectiveness but, as in most cases some spoilage of product is involved, the man-effectiveness ratio is influenced both by effectiveness per se and by spoiled work losses. In

such cases, the ratio expressing the relation of pay to man effectiveness, apart from spoilage, will be the labor-cost ratio before spoiled work is taken into account.

The ground has now been traversed. The main features of cost analysis and the development of significant ratios under the standard-cost plan have been described. It is interesting to observe how the conception, the procedure and the aim differ from those of the job-cost plan. On the basis of twenty items of given data, fifteen useful operating ratios and an interpretation of cost variations in seven sub-divisions have been obtained. This information is of greater usefulness than would be the cost of any particular job or lot produced or the individual costs of all jobs. Indeed, it might be that in the present example the figures represent numerous jobs in various stages of progress, none of which is finished. The information obtained would be the more valuable on that account, as the trend would be disclosed before all the work was done.

It is true that the cost ratios of actual to standard express the merged effect for all products. This effect by no means results in an average cost, because the standard cost of actual production is based upon respective standards for each article. The only tendency towards averaging is that the variations from standard are spread over all the articles currently made. When the variety of articles is such that an appreciable error might ensue from this cause, it is avoided by the logical classification of articles in product groups, for which separate figures are obtained. Then variations are spread within narrower confines, and the margin of probable error is maintained within reasonable limits.

The analysis of variations in net profits, made on the basis of standard costs, is not presented in the illustration, because these variations have mainly to do with sales. It will be better to take up the study in further detail of manufacturing cost variations, before considering the subsequent variations in profits from sales.

The foregoing analysis of the variations in actual costs from standard costs is made naturally on the basis that the standard costs represent expected performance. It was mentioned that under another method the standard cost does not represent expected performance, but merely a fixed basis for measurement and for analysis. Expected performance, in that case, would be at some degree of variance from the standard, and gains or losses would be the difference between actual results and the expected results. Here, then, are two different ways of using the standard-cost plan, having root perhaps in two different conceptions of the meaning of the term "standard costs"—on the one hand, to represent the ideal or par of performance; on the other hand, to represent a rule or measure only. It will be profitable to consider the two ideas, and the subsequent procedure and use of the data, depending as the matter does upon which of these ideas is in favor.

CHAPTER III

STANDARD COSTS AS IDEALS OR AS MEASURES

Meaning of Standard Costs

The standard cost of a product is that sum which is obtained by pricing a manufacturing specification for the product at predetermined basic rates for the materials, direct labor and burden entering into its manufacture.

Some confusion exists as to the definite meaning of the word "standard" when used in the phrase standard costs. This is partly due to the fact that the word has a number of meanings, several of which are appropriate. The sense in which the word is used depends upon the intent of the user; also, the methods followed differ somewhat according to the meaning adopted. The word "standard" may mean:

(1) A type, ideal or example to be used as a copy;
(2) An ideal, a criterion of excellence or ultimate object of attainment;
(3) A measure, rule; any established measure of extent, quantity or value.

The word is sometimes used in the first of these meanings to apply to a system or outline prepared for use uniformly by a number of concerns or branches or by companies in an industry. A standard cost system, then, would be one followed alike by those interested, irrespective of whether standard costs are embodied in the system or not. Many trade associations or like bodies have prepared uniform accounting systems, ranging in scope from merely a classification of accounts to complete cost and general accounting procedure. In some of these, standard costs are incorporated as a feature. Standard costs so incorporated are within the scope of present considera-

tion, but the uniform use of them is not. Uniform accounting for industries is another subject. It may, therefore, be understood that the use of the word "standard" to indicate a type or model system is not implied.

The second meaning of the word holds when the standard costs are intended to represent the desired costs: those which are the object of attainment and express the amount of expected costs under prevailing conditions. When so regarded, the standard costs are made up of the required proportions of material, labor and burden taken at the level of expected costs, such as market prices for materials and prevailing labor rates, with burden included at normal burden rates. Actual costs, then, are compared with them, and the differences are the gauge of accomplishment.

The third meaning of the word applies when the standard costs are established only as measures or yardsticks, set to include materials, labor, and burden in the right proportions, but at fixed price levels, unvaried as to prevailing trends in actual costs. It is the object to bring out these trends; therefore the standards are maintained unchanged in order to avoid the difficulties of comparing variables with variables. The standard dollar remains always the same, and it is the basis for disclosing the fluctuating values in the actual dollar as well as the fluctuating effectiveness in performance. Interpretation, when standard costs are so used, is not so much the comparison of actual with standard, as it is the comparison of successive achievements in relation to the same standard.

It is important that the distinction between these two concepts be clearly seen; standard-cost methods which are widely in use will be under one or the other of them. Discussions of the subject have wandered through lack of definition in this respect. Consideration of methods must depend upon whether the standard costs are to be current standard costs, representing desired results, or basic standard costs, representing fixed measures of current results.

Distinction in Methods

When standard costs are used as current standard costs, i.e., to express what products should cost, inventories of work in process and finished stock are carried on the books at standard costs, all

differences in the corresponding actual costs being diverted to variation accounts standing directly against profit and loss. (Frequently raw materials are also carried at standard costs. The difference between these and actual purchase costs is carried to a variation account immediately upon receipt of the material.) The theory is that the standard costs are the justifiable costs and deviations are likely to be the result of inefficiencies, causing losses which should be taken immediately or, at any rate, should not be set up as current assets. An awkward question arises if the deviations are profitable, as the result of bettering the standards. Consistency would require the gain to be taken up before the products are sold. It is recognized, however, that such practice would be contrary to sound accounting; so the policy generally is to absorb the losses but defer the gains until the goods have been sold. This applies to net losses or net gains in the aggregate for a period. Individual gains are treated as offsets to individual losses. A standard usually is set at a level which can be attained by the exercise of ordinary skill. This means of course that there may be individual performances above standard at the time when others are below standard. It is equitable to take the gains and the losses together, because that is the condition upon which the standards are predicated. The problem referred to arises only when there are substantial net gains in the aggregate.

On the other hand, when the standard costs are used as basic standard costs, i.e., only as measures or specifications, inventories of work in process and finished stock are carried on the books at actual costs and the corresponding standard costs are shown beside them in parallel columns. No deviation is made from these accounts for variations and the products are kept at actual costs of manufacture until sold; when sold, the accounts are relieved at actual costs and the corresponding standard costs are dropped. Thus the standard costs do not appear in financial statements, but all inventories are stated at the level of actual costs. (It should be mentioned that actual costs referred to include burden at normal rates only. It is now quite a common expedient to carry unabsorbed burden separately as a profit-and-loss item, because a loss through not running at capacity and therefore not absorbing the full burden is not chargeable properly to the cost of goods made under these conditions. It is regarded

as an element of manufacturing cost in the broad sense, applying to all products, not to the particular products made at any one period.)

The theory here is that it is incorrect to set up production at what it should have cost instead of at what it did cost; the first is a matter of opinion, whereas the latter is fact. If at the end of a fiscal period, owing to unfavorable conditions, stock on hand is at a high cost so that the margin expected to obtain on subsequent sales would be inadequate, any adjustment required to write down the inventory is to be regarded as an action of policy, not as a function of cost accounting. Under conservative management, reserves are provided against such contingencies. These reserves can be set up in the accounts without disturbing inventory costs, so that what may be an economic necessity is not extended into a practice of substituting standard for actual costs.

It will be seen from these definitions that methods, mainly because of the distinction in the conceptions of standard costs, differ so that when current or "ideal" standard costs are used, material, labor and burden variations are set apart and inventories are carried at standard, whereas when basic "measure" standard costs are used, only unabsorbed burden is carried apart as a variation, and inventories are kept at actual costs of material and labor, plus burden at normal rates for the degree of capacity run.

There is a certain appeal in the adoption of the standard cost as the object of attainment, arising possibly from the natural human impulse to consider a standard of any kind as something at which to aim or to which to conform—every man is attracted by an ideal. Moreover, since the beginnings of scientific management the word "standard" has come into wide usage in manufacturing circles in the sense of a par of performance. But it should be remembered that this par is not the par of the golf course, which relatively few can attain; it must be set as a practical matter within reach of average ability. It therefore follows that in business a standard can not be an impossible ideal, a criterion of excellence, or even an ultimate object; it must be reduced to the point of ordinary fulfilment. Hence it becomes more a measure of particular performance against average performance than a statement of aim, and the choice as to accounting plan in reality then is reduced to a question whether the

measure is to be changed so as to approximate the desired result or is to be maintained constant so as to bring out the variations from both expected and past performances in the actual result.

Although the principal difference between using current ("ideal") standard costs or basic standard costs lies in the treatment of variations, a number of difficulties may arise under the former plan which should be given consideration. One of these is the necessity for continual revision of the standard costs. Obviously if these are to be current and are to represent what products should cost and are to be the means of inventory valuation, they must be kept abreast of changes in the prices of materials and in labor rates. Otherwise the central theory would not be carried out and, of more practical bearing, the variations might become large. When the conditions permit such revisions to be made easily, so that variations are confined within narrow limits, the objections on this account do not arise. Under these conditions, the current standard-cost method is quite satisfactory, although it must be recognized that the cumulative benefits to be derived are sacrificed, because the current standard costs relate only to current results.

It is frequently found that this plan is adopted but the standard costs are not revised as often as is really necessary. This leads to an undesirable state of affairs—the standard costs are neither current nor basic and the variations are essentially bookkeeping adjustments. The standard costs then do not represent what products should cost nor (being occasionally changed) afford a fixed basis for interpreting results. Therefore, in all cases when it is not feasible to keep the standard costs revised continuously so that all price changes are promptly reflected in them, it will be far better to adopt fixed basic standard costs.

There are other undesirable features of the standard ideal cost plan which exist because under it standard costs in effect are substituted for actual costs.

Objections to Substituting Standard for Actual Costs

When inventories are carried at current standard costs, goods sold are necessarily recorded at their level; hence the margin is the difference between actual sales and standard cost of goods sold. Gross

profits, therefore, can not be accurately expressed by kinds of products, because the variations in costs, which arose upon their manufacture, were removed from the inventory accounts. In order to calculate actual gross profits it would be necessary to carry the separated cost variations by classes of products, in harmony with the inventory accounts, so that a commensurate share of the variations could be restored to standard cost of goods sold. It is not the usual practice to carry variation accounts in this arrangement. If it were done, the question would immediately arise why the variations should be diverted in the first place, instead of retained in the inventory accounts. When it is not done, any attempt to apply the variations to cost of goods sold entails the inaccuracy of proration.

Also, the customary practice in disposing of material and labor variations at the time goods are made is to charge off the losses at the end of each month, showing them as deductions from "normal" gross profits (i.e., sales less standard cost of goods sold). This often causes a difficulty, because production and sales ordinarily are not uniform. There is rarely a direct relation monthly between the variations charged off and the profits realized. The former are on production, whereas the latter are on sales. Under modern methods for stabilizing production by following manufacturing schedules set for the purpose of avoiding seasonal fluctuations, this practice conceivably would cause the heaviest losses to appear during the months when the profits are lightest.

Another problem encountered when the standard costs are to represent expected results is that it becomes necessary to make allowances in establishing the figures for variations in yield which are incidental to the manufacturing process. The yield obtained in good product will vary through spoilage, scrap, shrinkage, and other causes, the effect of which should be introduced in the standard costs if they are truly to represent expectations. But yield fluctuates, and the difference between actual and standard costs on this account is then a variation from a variation in yield, and it is often a complex matter to separate from the total variations in yield for a given period that part which has already been discounted and introduced in the standard costs.

It will be apparent that when the standard costs are revised fre-

quently, the advantage of bringing out the trend of development over a period is sacrificed. Comparisons of effectiveness in performance at different periods under different standards can not readily be shown relatively. Therefore much of the cumulative value of the data is lost.

Certain problems arise in adjusting the inventories for revised standards. If the inventories at the commencement of the fiscal period are carried at standards different from the inventories at the end, the effect upon earnings must be taken into consideration and may require adjustment. Also, at each revision of the standard costs, the effect of the change in standards must be computed to the extent of stock on hand at the time, because subsequent deliveries from stock will be carried at the revised standard costs.

These disadvantages must be considered in the light of the circumstances on installing standard costs, if the costs are to be regarded as current standards.

Basic Standard Costs as Measures

Under the concept of standard costs purely as measures or yardsticks (instruments for calculation) the standard cost of an article is in no respect a "cost"; it is only an initial formula, expressed in a common denomination of standard dollars and requiring adjustment by correction factors before use for costing purposes. The manner of adjustment depends upon the purpose in view, as stated in a previous section. If cost estimates are sought, for quotation purposes, for setting selling prices, or for deciding upon proposed manufacturing programmes, the correction factors are selected ratios, to be applied to the basic standard costs respectively as to materials, labor and burden. The ratios used should be such as to bring materials to the level of market or expected cost, labor and burden to the levels indicated by experience to be normal and reasonably attainable. If cost of production is to be obtained, for setting goods in stock or for costing goods sold, other correction factors are applied, the ratios used in this instance being those which have accumulated in the manufacturing accounts. If comparison is sought between actual cost of production and expected cost, the latter is computed by using appropriate ratios to standard, representing expected results. Throughout such calculations, the standard costs remain intact as the basis for all reckoning.

This plan avoids the objections which have been cited and on the whole affords more in the nature of return for the effort expended. Its main disadvantage is the novelty, if it might be so called, of the conception of the purpose and use of the standard costs, which is at first confusing to those accustomed to the other meaning of the word "standard", namely, as the ideal. This is overcome when the principle of using a standard solely as a measure is understood.

It is sometimes thought to be a disadvantage of this plan, as compared with the plan of using current standards, that more work is involved, because dual figures are carried, i.e., actual and standard costs. This is not really the case, inasmuch as double computation is not required. The details of operating costs are taken at standard only and are summarized into classified cost accounts, to which the actual costs are carried in corresponding totals. The clerical work is about the same under both plans, but this does not include the frequent revising of the standard costs, which, of course, is necessary only under the current standard plan. On the other hand, when basic standards are used, an extra calculation is required in operating reports to express expected results, but this calculation can be made in totals and is not equivalent to revising the standards when the products are considerable in number. As compared with the job-cost plan, it may be stated generally that either method for the use of standard costs should entail less clerical work as well as furnish information of greater practical value.

Comparison Between the "Ideal" and the "Basic" Standard Cost Methods

It will be worth while, in the interest of a clear understanding of the like and the unlike features of the two methods for the use of standard costs, to follow the application of the principles which have been described in a concrete example. For this it is necessary to assume figures and specific transactions, such as are displayed in the accompanying chart III, Appendix, in which the figures, although abbreviated for the sake of simplicity, are complete and representative of the procedure under both methods.

It is assumed that three products, differing in the kind and amount of labor, burden and material required, are manufactured. Three materials are used, and the manufacturing operations involve two departments. The proportion of labor, burden and material to the total are different for each article, and the labor and burden vary in the two departments. Two of the products pass through manufacturing processes in both departments, but the third product is completed in one department.

Fig. I in the chart illustrates basic standard (measures) costs set for these specifications. In the subsequent procedure, these basic standard costs remain unchanged, although changed price levels to be expected are assumed.

Fig. II shows the expected changed price levels for labor, burden and material. The trend is downward, indicating that actual costs at appropriate lower levels are to be expected in the manufacture of these products under the conditions to prevail in the immediate future.

When the standard costs are to represent these expected cost levels, they must be revised to incorporate the effect of the lower price levels expected. Fig. III shows the standard (ideal) costs for the same products reduced to the lower price levels.

Obviously, the transactions under actual operating conditions will not be precisely at the expected price levels. It is therefore assumed that the actual price levels differ from the expected price levels, (Fig. IV) although for the sake of simplicity, the fluctuation is confined to material, and labor and burden are shown actually to stand at the expected price levels. It will be understood that they may not be, and probably will not be, so in reality.

The assumed operations are shown in Fig. V, and corresponding calculations for the same transactions are given in adjacent columns, under the standard (ideal) plan at the left and under the basic standard (measure) plan at the right.

The actual payroll in department I is computed at $2,580 (3F), arising in the manufacture of certain products, 120 of "A" and 100 of "B." In department II, the payroll is $8,415 (7F), incurred in the manufacture of 130 of "A", 90 of "B" and 80 of "C". Presumably products "A" and "B" go through processing first in department I

and then in department II. Different quantities in the production of each article are assumed, in order to indicate a fluctuation in work in process, although, to avoid unnecessary complication, the calculations are made as if all the operations on each of the products were completed in both departments. It appears, from the report of finished products transferred to stock (34, 38) that not all of the products "A" and "B" were delivered from processing. All of product "C", made in department II, however, was delivered to stock (42).

The standard (ideal) costs, equivalent to the departmental production, are shown in column E. (We are concerned for the time being exclusively with the accounting of the standard-ideal-plan.) For labor, these aggregate $9,630 (8E). Inasmuch as the actual payroll is $10,995, a labor variation is disclosed, which is charged to "labor variations" in the accounts and the remainder of the total payroll, namely the standard labor cost of production, is charged to work in process (Fig. VI).

Reverting to Fig. V, the actual burden is $6,710 (11F). The standard burden, equivalent to the production reported in each department, aggregates $5,696 (19E). The difference between actual and standard burden is charged in the accounts to "unabsorbed burden" and the standard burden is charged to work in process (Fig. VI).

Material purchases made during the period (Fig. V) cost $41,650 (23F), whereas the standard cost for the same quantities aggregates $48,600 (23E). The saving of $6,950 is carried in the accounts to the credit of "material purchasing variations", and the material is set up in raw material accounts at standard cost (Fig. VI). This is the usual procedure, although at times the variation is not separated until the raw material is actually put into process.

The material used (Fig. V) is reported in quantities. When these quantities are extended at standard costs and compared with the standard cost of the quantities which should have been used, obtained by extending the number of articles manufactured at the standard material cost for each (24-33E), a difference is disclosed which is attributable to excess usage. This difference is charged in the accounts to "material usage variations", while the standard material cost for the articles made is charged to work in process (Fig. VI).

Finished products transferrred to stock are priced and extended at standard costs (V-34-46E). The total amount is transferred at standard from work in process to finished stock (Fig. VI), out of which $33,000, at standard cost, is taken for shipments made against sales, i.e., standard cost of goods sold.

This in essence completes the accounting under the standard (ideal) plan. The variations which arose in actual operations have been carried to variation accounts, apart from the inventory accounts for raw material, work in process and finished stock, which are carried at standard costs. The closing book inventory, amounting to $85,774 (VI), appears in the balance-sheet at standard cost. The variation accounts are closed out to profit and loss.

The profit-and-loss account, under this procedure, appears as shown in Fig. VI. The total standard cost of sales, $33,000, is computed, so that separate amounts are obtained for each of the three products. Different margins are assumed for these products. Product "A", smallest in quantity sold, shows the highest margin, 30%. Product "B" carries a margin of 20%, while product "C", sold in the largest volume, carries a narrow margin of 15%. When the total margin, i.e., the difference between actual net sales and standard cost of sales, is ascertained, the balances in the variation accounts are applied to it, losses are deducted and gains added. In the example, a net gain of $3,459 appears, due to the substantial saving made in the purchase of raw material. The resulting gross profit for the period is $11,529.

Taking up now the calculations and the accounting for the same transactions under the basic standard (measure) plan, the actual payroll of $10,995 (V-8F) is charged to work-in-process accounts, sub-divided as to products "A", "B" and "C". The corresponding basic standard costs (V-1-8G), obtained by pricing and extending actual production at the fixed basic standard costs (Fig. I), are also carried to the work-in-process accounts in adjacent columns (Fig. VII).

Burden to be absorbed in cost of production is carried to the work-in-process accounts similarly, in actual and standard amounts. The latter are obtained (Fig. V) by pricing the articles produced in each department at the basic standard burden cost (V-12-19G). The

former, which in reality is not actual burden, but the part to be absorbed on the basis of the manufacturing capacity used, is obtained by pricing the number of hours actually run at the normal burden rates per hour for each department (V-12-19F). It should be noted that the hourly burden rates used for this purpose have been adjusted downward to the expected price level for burden, which is 80. Accordingly a rate of 20c an hour is used in computing absorbed burden for department I, instead of the basic standard rate of 25c an hour. For department II the rate used is 40c, instead of the basic standard rate of 50c. This expedient avoids introducing burden into actual costs at a high level that is not applicable to the current period. The calculation of absorbed burden thus is on the same basis as to price level under either standard-cost plan, but with this difference: whereas under the standard (ideal) plan the amount absorbed is standard burden only, under the basic standard (measure) plan, the amount absorbed is computed for the hours actually run, so that the burden absorbed is influenced by running effectiveness. This is as it should be, because, if running time is excessive, the burden cost of production is greater; if running time is reduced, the burden cost of production obviously is less.

When the current labor and burden costs have been charged to the work-in-process accounts (Fig. VII) and added to the balances in those accounts representing the inventory of work in process at the beginning, the totals contain the influence of the labor and burden variations which actually occurred. The amounts under "actual," therefore, represent actual cost (with burden at normal rates). The amounts under "standard" afford the basis of measurement; and the ratio between them is the merged ratio of actual to standard costs as to work in process at the beginning and operations during the period. This ratio is to be used subsequently in adjusting, to the level of actual cost, products delivered into finished stock priced at basic standard costs.

Material purchased is charged to raw-material accounts at actual cost (Fig. VII). It is not necessary to compute the equivalent basic standard cost, because the material-purchasing variation is not to be removed from actual costs. (An advantage is found in carrying standard costs as well in raw-material accounts, at times when in-

ventory discrepancies arise, inasmuch as the standard costs are quantitative measures.)

Material used (Fig. V) is credited to raw-material accounts at actual cost and charged contra in work-in-process accounts. These accounts may be arranged by material classes, as illustrated (Fig. VII), or otherwise, as may be most suitable. The basic standard material cost charged to the work-in-process accounts, beside the actual costs, are obtained by pricing production during the period at the basic standard costs for material (V24-33G). The production for this purpose is that of the initiating department, without regard to the production of the same articles from subsequent operations in succeeding departments, since to include it would plainly be duplication.

The ratio of actual to standard material cost obtained in the work-in-process account has merged in it the influence of both the variation in price and the variation in consumption, because the actual cost of material used and the basic standard cost of the material which should have been used according to manufacturing specifications have been set down. The merged cost ratio is used later to bring to the level of actual cost the material priced at basic standard costs in products delivered to finished stock.

Finished articles turned over to stock from work in process are priced at the established basic standard costs, in subdivisions corresponding to the classification of the work-in-process accounts (V-34-45G). The commensurate actual costs are found by applying the merged cost ratio standing in each account to the basic standard cost of all deliveries. Actual and basic standard costs are then carried to the finished stock account, which is shown classified by products (Fig. VII). In this account, the charges are again combined with the opening inventory, in order to obtain a merged ratio of actual to standard cost for stock on hand at beginning and production transferred since. As in the previous instances, this merged ratio is used for adjusting to the level of actual cost products taken from stock at basic standard costs for shipments on sales.

When shipments, priced at basic standard costs, have been adjusted to the level of actual cost by the application of the merged cost ratio standing in the finished-stock account, the basic standard

costs are dropped and only the actual cost of goods sold is carried to the profit-and-loss account (Fig. VII).

The burden absorbed, which, as previously described, is on the basis of hours actually run, will not in the aggregate equal the actual burden except by rare coincidence. The difference between actual burden (V-19F) and the amount absorbed is "unabsorbed burden" and is charged to an account under that name (Fig. VII).

When these entries in the accounting under the basic standard (measure) plan have been made, all costs appear in financial statements on the basis of actual cost (with burden considered actual at normal rates for time run). The closing book inventories appear in the balance-sheet at actual cost, ~~$88,916~~. The profit-and-loss account shows an actual gross profit of ~~$2,060~~ (Fig. VII).

Review of Procedure and Results

Having traced completely the accounting under both plans for using standard costs, let us review and compare the procedure and the results, considering in this concrete case, based on common transactions, the more prominent features of advantage and disadvantage. Examining the profit-and-loss accounts (Figs. VI and VII), we find that gross profit is misstated under the standard (ideal) plan. In the present example it is an over-statement. Evidently, it might as well be an under-statement, depending entirely upon the trend of variations in the period. Part of the over-statement arises from anticipation of the saving made in purchasing raw material, offset to a certain extent by like anticipation of manufacturing cost variations, as they apply to production in the period in excess of actual shipments.

The remaining part consists of a serious distortion in the expression of the margin obtained on each product. As to product "A", the margin on the basis of standard cost appears to be 30%, whereas, on the basis of actual cost, it is 22.8%, because the actual cost of product "A" is about 10% above expectations.

As to product "B", the margin appears to be 20%, whereas it is 7.7%, again owing to an increase in actual cost. A marked disparity is disclosed as to product "C", which shows an actual loss, instead of an apparent margin of 15%. The substantially increased cost of

sales of product "C" is due to low effectiveness in its manufacture, as can be seen from the effectiveness ratios in Fig. V (J6, 17, 28).

It is clear from this example that a possibly serious disadvantage of the standard (ideal) plan is that the procedure results in applying variations arising from purchasing and producing against the margin on sales in the period, and that the margin as to particular products is misstated by the omission of variations which in reality were part of actual manufacturing cost, some portions of which, to an extent that can not be clearly seen, have been taken up in the profit-and-loss accounts of prior periods.

Another feature is that under the standard (ideal) plan, the inventory is under-stated in the present example, because the standards are below actual cost. The inventory, of course, would be overstated if the situation were the reverse—that is, if actual cost was below the standards. Then, sound accounting principle would require an adjustment at the close of a fiscal period, to reserve an amount sufficient to reduce the inventories at standard to the basis of actual cost or market, whichever is the lower.

The argument is advanced, when the situation is like that assumed in the example, that in a period of declining prices and with standard costs below actual costs, the procedure at all events is conservative. The cost variations which are charged off represent inefficiencies, the losses from which it is better to take at once and be rid of them. The argument is sound and would raise no reasonable objection, from the standpoint of valuation of inventory, (if standard costs are not above market) provided the variations truly represent inefficiencies. Frequently, however, some of the "inefficiencies" are a normal and inseparable part of the manufacturing undertaking. Therefore, so far as this is the condition, the losses arising are a normal and inseparable part of actual manufacturing costs, and to omit them is merely an expedient resulting in carrying products in inventory at what it is desired they should cost, rather than at what they did cost. Hence, from the standpoint of an accurate knowledge of costs and, as we have seen, of a correct expression of profit margins, nothing is gained by carrying inventories at standard cost.

An advantage under the basic standard (measure) plan, which is

lacking in the other, lies in the absorption of burden on the basis of actual rather than standard time. When standard burden only is absorbed, the effect upon costs of the variations in manufacturing effectiveness is not disclosed. The burden cost set up for a given production, therefore, is the same whether one thousand hours or two thousand hours were run. Moreover, it is useful to obtain percentages of capacity used and remaining unused. This information can not be obtained on the basis of standard burden absorbed, because it represents in percentage to the budget merely the per cent. of capacity that should have been used for current production, and there is lacking the ready means of measuring departmental effectiveness with respect to burden, which in many instances is machine effectiveness. This information can be obtained from the ratios of actual to basic standard burden cost (Fig. V). These ratios, when divided by the price level for burden at which it is known burden is absorbed, will yield ratios of actual to standard time, and vice versa, of effectiveness. For instance, in department II, as to product "C", the burden cost ratio is 84 (17H). The price level is 80—dividing it into 84 gives the ratio of 105 of actual to standard time. Therefore machine effectiveness (assuming burden to be absorbed on the basis of machine hours) in department II on the manufacture of product "C", is 95 (17J).

Another feature in which the two plans differ should again be mentioned, that is, the treatment of yield variations. For the sake of simplicity, no yield variations are introduced in the standard costs (Fig. III), which are on a net good product basis, the same as the basic standard costs (Fig. I). In practice, it would be necessary to make allowances in the standard costs (III) for expected yield variations. These allowances need not be made in the basic standard costs (I), because the variations in yield which actually occur are absorbed in actual cost and are disclosed by cost ratios.

In the present example, the yield variations which occurred can be obtained under the standard (ideal) plan by pricing the quantities of material actually used at standard prices and comparing the total with the standard material costs (Fig. V-24-33), representing the material that should have been used. Any difference indicates over- or under-consumption, in terms of standard cost. The same

information is obtained under the basic standard (measure) plan by dividing the ratio of actual to basic standard costs by the material price ratio. For instance, as to material "X" used in the manufacture of product "A", the cost ratio is 77, which, divided by the known material price ratio of 70, indicates a consumption ratio of 110 (24J). This distinction is to be observed, however, in the resulting amount obtained for the usage variation: whereas under the standard (ideal) plan, the amount of the variation is disclosed as a loss of:

Material "X" used for product "A":	
Actual quantity at standard cost (10,560 x 40c)	$4,224
Should have used at standard cost (Fig. V, 24E)	3,840
Usage variation, loss, at standard	$ 384

under the standard (measure) plan, this variation preferably is expressed at actual cost, as follows:

Material "X" used for product "A":	
Material cost ratio	77 (24H)
Known material price ratio	70 (20J)
Material usage ratio	110 (24J)
Usage variation, loss, at actual (10/110 × $3,696)	$336

If an allowance has been made in the standard cost (III) for an expected yield variation, then the calculation of the actual yield variation beyond this allowance involves the step of first ascertaining how much allowance is included in the standard material cost of production, so that this may be subtracted from the total usage variation in order to ascertain the excess variation.

To Change or Not to Change Standards

It is clear from this review of the procedure and the main features under the two plans that the essential difference between them arises from whether or not the standards are revised continually to keep pace with changing price levels. Otherwise, both standards are similarly specifications for the manufacture of products, and the

standards are changed under either plan to conform with any changes and improvements adopted in manufacturing processes, because, in substance, such changes affect the product or at least the proportions of its elements and hence call for new specifications. There is, therefore, no point of difference in this type of revision; the difference is in incorporating fluctuating price changes as well.

The divergences narrow and the two plans approach uniformity, when, on account of simplicity in products and manufacturing processes, the work of revision is not burdensome, and the standards can be revised regularly and as frequently as necessary to maintain the central theory that the standards at all times shall represent the desired results. The same may be said even when the products and operations are complex, if the conditions of manufacture are practically set in advance for a season by means of purchase contracts and production schedules. For instance, in the manufacture of stock automobiles, the specifications of the season's models, as well as the selling prices, are determined in advance, and material requirements are covered by purchase contracts. In such cases, the conditions make it unlikely that there will be any great changes in price levels. In either case, the result is that the standard costs are fairly close to the actual costs; it is deliberately prearranged so, and distortions in profit margins and inventory values are avoided or at least minimized.

So much should be said impartially in favor of the standard (ideal) plan when comparing the two. Also it can be said that the accounts are simpler than the classified inventory accounts used under the basic standard (measure) plan; they are indeed elementary, consequently they are much less useful as sources of analytical information. The facility with which operating data, particularly operating ratios, can be combined to analyze and interpret the figures, to bring out trends and project their tendencies, is greatly curtailed under the standard (ideal) plan, on account of the shifting basis of the standards; and it is notable that the analysis of variations in net profits (described in a subsequent chapter) entails revising all sales budgets in conformity with standard-cost revisions.

When all these considerations are summed up and the pros and cons as to procedure and results under both methods are weighed,

it will be found in most cases that the basic standard (measure) plan is more suitable for the requirements and affords more by way of return, upon a given expenditure of effort, in the form of useful operating data. The metric (measurement) principle is logical and the application of it is simple, when it is understood that the basic standard cost is merely a calculating and measuring instrument. As such, the values given its terms are unchanging, in order that the dimensions of things to be measured can be found and compared with the desired or expected dimensions. The latter is the "standard" in reality, in the sense of objective or criterion. It is inefficient to alter the instrument with each measurement to fit the thing being measured. The more direct and reasonable way is to compare successive measurements, taken with the same rule. Obviously, a broader view and better understanding are obtained from a comparison of variables with constants than are possible from a comparison of variables with other variables.

For these reasons in theory, and in practice, to avoid the difficulties and distortions which have been reviewed and may be consequent upon revising standard costs to conform with changing price levels, as under the standard (ideal) plan, the conclusion is justified that, of the two, the basic standard (measure) plan is to be preferred.

Analysis of Manufacturing Cost Variations

Although the preceding review has covered completely the essentials of principle and procedure in the use of standard costs, consideration has not been given in sufficient detail to the important features of the analysis of the variations of labor, burden, material and unabsorbed burden costs, nor how the figures are brought together and the ratios are used to disclose effectiveness and to find the amounts of gains or losses realized. In order to give proper consideration to these features, attention must be concentrated on them unhurriedly and not subordinately. They can now be studied, separately as to labor, burden, material, etc., with more ease and greater benefit after having first reviewed the general outlines of the subject.

CHAPTER IV

ANALYSIS OF LABOR COST VARIATIONS

Labor Cost Variations

Figure 8

Actual payroll, direct labor	$16,200
Production, at standard labor cost	13,500
Labor cost ratio	120

In the figures above given, the actual payroll is the total of wages earned for a period, not necessarily paid. Production means work performed in a given department or part of a department, whether salable finished products are turned out or not. Therefore, the standard cost of production corresponds to the actual payroll.

The relation between them is the labor cost ratio, 120. Labor costs are bound to vary from standard. The time required will differ, but, aside from labor effectiveness in production, there will be variations even if all the operations are scheduled on a piece-work basis. There will be allowances which have to be made for unfavorable circumstances for which the worker is not responsible or for guaranteeing a minimum wage to the less skilful workers. If all workers succeeded in earning standard piece-work rates, there would still be a labor-cost variation on the whole, arising from work spoiled in operations, to the extent of the labor cost which had accumulated up to the point of spoilage. In other words, wages will have been paid for good work performed lost at a later stage, where, for any reason, the product has to be scrapped. Or the operations actually performed may differ from those contemplated in the standard costs.

Assuming the standard labor cost to be a basic standard fixed

as a measure, the labor cost ratio of 120 is of limited significance by itself. It is used to compare the trend of this performance with previous performances. For instance, if the labor cost ratios ran:

110, 112, 115, 118, 120,

it is clearly evident the trend in labor costs is definitely and steadily upward, indicating that the causes of variation are continuous and presumably in the wrong direction. If the ratios ran:

114, 112, 114, 113, 120,

it is evident that the last variation is an unusual fluctuation not present before.

Proceeding with the analysis of the labor cost variation and assuming that, based on experience over a sufficient number of periods, the expectation as to the labor cost ratio is that it should be 113, one may readily compute the variation between actual and expected costs:

FIGURE 9

Standard labor		$13,500
Expected labor cost ratio	113	
Actual labor cost ratio (Fig. 1)	120	
Variation, increase in cost	7	$ 945

The increase in cost over expected cost is 7% of standard cost. Both ratios above given are in relation to the standard labor cost, $13,500 (Fig. 8). The total variation, therefore, is 7% of this amount, namely $945. Two underlying factors of variation combine to produce this result, namely, the output factor, resulting from the time actually required for the stated production, and the rate factor, representing the average hourly pay (see diagram, Fig. 7, page 20). The variations arising from these factors can be resolved by simple calculations based on the standards.

OUTPUT

Inasmuch as the labor cost ratio is an end ratio containing the time change and the rate change, it is the product of two other

ratios, that is, one expressing the relation between actual and standard time and the other expressing the ratio between actual and standard hourly rates of pay. If either one is found, the other can be determined by dividing it into the labor cost ratio; the quotient must be the remaining ratio. Usually the ratio for the time element is easiest to ascertain:

FIGURE 10

Actual man-hours, direct labor	18,190
Production, in standard hours	16,070
Time ratio	113.2
Labor output (100 ÷ 113.2)	88.3

Net good production, valued in terms of standard time, aggregates less than the actual man-hours reported. Consequently, the time ratio is above standard. The output ratio, which is the reciprocal of the time ratio, indicates over-all effectiveness in labor operations for current production.

The time ratio, 113.2, as was stated, is a component of the labor cost ratio, 120. The other component must be the hourly pay ratio.

FIGURE 11

Labor cost ratio (Fig. 1)	120
Time ratio (Fig. 3)	113.2
Hourly pay ratio (120 ÷ 113.2)	106

The hourly rates of pay are 106% of standard. This is borne out by the figures on average hourly earnings, which are: actual 89c. $\frac{(\$16,200)}{(18,190)}$ and standard 84c. $\frac{(\$13,500)}{(16,070)}$.

The labor cost ratio 120 has now been resolved. It is evidently the result of paying wages at the rate of 106% of standard, for time at the rate of 113.2% of standard. Both trends are upward in this example. It will be understood that they may run in opposite directions, but in all cases the labor cost ratio will be the product of the two ratios.

It may be desired next to ascertain how much of the increase in cost of $945 (Fig. 9) arises from each cause. It was assumed that the labor cost ratio expected is 113. Let us further assume that it was expected that this would be composed of a time ratio, 110.8, and a rate ratio of 102. In other words, on the basis of experience, variations to the extent of these ratios are expected and would be regarded as reasonable.

There are then the following facts with which to deal:

FIGURE 12

ANALYSIS OF LABOR COST VARIATIONS

Actual results		*Expected results*
113.2	Time	110.8
× 106	Rates	× 102
120	Cost	113

Both time and rates show increases over expected results. The apparently high ratio of expectation as to time requires explanation, because it would seem logical to expect a ratio of 100 for this factor, if the time used in establishing the standard costs was reasonably accurate. There are two variable operating conditions which may be expected as normal occurrences, causing the expected time as a whole to be higher than standard time. These conditions are (1) that a portion of the product manufactured will be spoiled before completion and (2) an allowance must be made for beginners or for other circumstances affecting the attainment of standard time in the performance of operations, which can not well be introduced in establishing the standard costs. These factors will be considered in later analyses.

The ratios representing actual and expected results set down in Fig. 12 relate to the same base, namely, standard costs. Consequently, by reckoning the differences in the ratios, it is possible to set down the increase or decrease in actual costs attributable to each change which has occurred:

FIGURE 13

ANALYSIS OF LABOR COST VARIATIONS
Time variation

Cost, had time been as expected:		
Expected time (Fig. 12)	110.8	
Actual rates (Fig. 12)	× 106	
	117.43	
Actual cost (Fig. 12)	120	
Increase, through time variation	2.57	$347

Standard cost = $13,500; (Fig. 8)

If the time had not varied, but had been exactly as expected, while the rates alone had changed, the labor cost ratio would have been 117.43 (the product of 110.8 for expected time and 106 for the actual pay rates). As it is actually 120, the time variation caused an increase, and the extent of the loss is 2.57% of standard cost, which is $347. This amount is part of the entire increase in labor cost, which was previously found to amount to $945.

The rate variation can be computed in a similar manner:

FIGURE 14

ANALYSIS OF LABOR COST VARIATIONS
Rate variation

Cost, had time been as expected (Fig. 13)	117.43	
Cost, had both time and rates been as expected; i.e., expected cost (Fig. 12)	113	
Increase through rate variation	4.43	$598

Standard cost = $13,500; (Fig. 8)

In the previous calculation, it was found that if time had been as expected, the labor cost ratio would have been 117.43. Had both time and rates been as expected, the expected cost ratio of 113 would

have been realized. The difference must be due to an upward rate variation. It amounts to 4.43% of standard cost, which is $598. This is the remainder of the total cost variation of $945.

The two calculations may now be brought together and the story displayed in one table:

FIGURE 15

ANALYSIS OF LABOR COST VARIATIONS

Standard cost	*Expected cost*	*Actual cost*	*Variation*
$13,500	15,255	16,200	945

Ratios to standard			*Variations*	
Actual	*Expected*	*Factors*	*Increase*	%
113.2	110.8	Time	$347	2.57
106	102	Hourly pay	598	4.43(a)
120	113	Cost	$945	7.00%
117.43	117.43	Cost, had time not varied (110.8 × 106)		
2.57	4.43	Variations		

(a) Check: 106 — 102 = 4 × 110.8 = 4.43

By this method of calculating the variations, the amount shown for the time variation represents the amount actually lost (or gained) from this cause. In other words, in the instant case, if the time variation had not occurred, $347 would have been saved, at the prevailing pay rates. The loss is the result of the increase in the time ratio, taken at the pay level of 106. The amount shown for the pay variation, $598, on the other hand, does not represent the effect of the increased rates for the full actual time, but for the expected time only, that is to say, for the task. The amount, $598, is the result of the increase in the pay ratio taken at the level of the expected time.

Some authorities prefer to make these calculations the opposite way—that is to say, to express the time variation at the expected rate and the rate variation for the full actual time. If this were done in the present example, the figures would appear as follows:

Time variation	$334
Rate variation	611
Total	$945

Then the rate variation, $611, represents the amount which would have been saved had the rate not varied, but the time variation, $334, represents the amount which would have been gained had time not varied, computed at the expected rates only. There is little to choose between the two methods, so long as there is no great difference between actual and expected pay rates; otherwise it is preferable to make the calculation as first described. It results in an accurate expression of the time variation; this also facilitates subsequent analyses.

INCIDENTAL VARIATIONS

It should be explained at this point why the calculations are not made so as to show, for the time variation and the rate variation respectively, the exact amount which would have been saved on each had the loss on the other been the only change, or, to put this in other words, to show correctly the amount of the loss which would be saved were one variation eliminated while the other remained. It can be done, as has been seen, by making the calculation both ways, but the sum of the two amounts thus derived will not agree with the total cost variation. This is due to the fact that the two elements are inter-related, so that a change in one affects the other and an incidental variation arises. In the figures used (Fig. 15), this incidental variation amounts to $13, which is the extent by which the sum of the variations, if calculated separately, would exceed the total cost variation of $945. This will be clear from the following example:

FIGURE 16

ANALYSIS OF LABOR COST VARIATIONS

Incidental variation

Cost, had time alone not varied from the expected		*Cost, had rates alone not varied from the expected*	
Expected time	110.8	Actual time	113.2
Actual rates	× 106	Expected rates	× 102
	117.43		115.46
	$15,853		$15,589
Actual cost	16,200	Actual cost	16,200
Time loss at actual rates	*$ 347*	Rate loss for full actual time	*$ 611*
			Total..$958

Actual total variation (120 — 113 = 7).....	*945*
Incidental variation	*$ 13*(a)

(Standard cost $13,500)

(a) Increase in time 2.4 × increase in rates 4.0 = .096 × $13,500 = $13.

It is needlessly complicated to introduce a third variation in the analysis and, for practical purposes, it is better to combine the incidental variation with the rate variation, making for simplicity in computation and a better understanding of the results.

The analysis made in Fig. 15 of the labor cost variations has not disclosed contributing causes, some of which are sufficiently prominent to warrant special procedure for bringing out gains or losses on account of them. One such cause is spoilage of products before they are finally made or, what amounts to the same thing, rejection of final products on account of defects.

SPOILED WORK

Allowances are not made in the standard costs for spoiled work. (This is the case when basic standard costs are used as measures. On the other hand, if they are used in the ideal sense, to be regarded as representing "true costs", average allowances for spoiled work must be made in setting the standard costs. Then later some means must be found for separating from spoiled work as a whole

the variation, more or less than expected, and the accounts must be adjusted to this extent.) It is the object to bring out such losses. This can be done whenever it is possible to report spoiled products separately, distinct from scrap.

It is the practice under some methods to consider losses from work spoiled in course of manufacture as a proper charge to the overhead of the department in which the loss occurred, on the theory that it is the responsibility of the foremen to control spoilage. While the reasoning is plausible, it is the fact, nevertheless, that this treatment of the loss will cause inaccurate costing by kinds of products unless a single product is made in the department, because the degree of spoilage will differ between products. Furthermore, under the procedure now commonly followed, of absorbing burden in costs at normal rates, the spoilage variations would not get into costs by products at all unless some provisions were made in the normal rates, and that would involve other difficulties.

Spoiled work losses, when identifiable, should be treated as direct costs, as nearly as possible as they arise by kinds of products. When it is not practicable to distinguish between spoiled work and scrap (meaning by scrap the waste of material in processing, aside from defective manufacture), the whole must be treated as a scrap variation, in material costs.

The loss and consequent increase in labor costs through spoilage of product can be brought out as follows:

FIGURE 17

ANALYSIS OF LABOR COST VARIATIONS

Spoilage ratio

	Actual	*Standard*	*Ratio*
Actual payroll, direct labor.....	$16,200		
Gross production, at standard labor cost		$14,087	
Labor cost ratio (before spoilage).....			115
Spoiled work, at standard labor cost...		587	
Net production		$13,500	
Labor cost ratio, net			120
Spoilage ratio		104.35	

Spoiled work is deducted at the standard labor cost accumulated to the point of spoilage. The labor cost ratio before this deduction was 115 and afterward is 120. The spoilage ratio can be expressed as the relation between them, namely 104.35 (120 ÷ 115).

The spoilage ratio is useful as a barometer of such losses. It can also be used to analyze the increase in labor costs, so as to bring out how much is due to a true time (effectiveness) variation, on the one hand, and how much is due to spoilage. Obviously if the man-hour ratio (the relation between total actual man-hours and standard hours for net good product) is 113.2 (Fig. 10) and the spoilage ratio comprised therein is 104.35 (Fig. 17), the effectiveness ratio, which is the remaining factor, can be found by dividing the latter by the former. So the effectiveness ratio is 92.2; that is to say, the ratio of actual to standard hours for gross production is 108.5 (reciprocal of 92.2). It was increased to 113.2 by the rejection of spoiled products. On this basis it is possible to split the time increase in labor costs of $347 between spoiled work and man effectiveness. Following are the facts:

FIGURE 18

ANALYSIS OF LABOR COST VARIATIONS

Ratios to standard

Actual results		*Expected results*
104.3	Spoilage	107
×108.5	Effectiveness (a)	×103.5
113.2	Time (b) (Fig. 12)	110.8

(a) Man-hours on gross production.
(b) Man-hours on net production.

The ratios indicate that there is hidden in the over-all increase in time, previously ascertained, a decrease in spoilage from the expected performance. The extent of the spoilage variation is computed in this manner:

FIGURE 19

ANALYSIS OF LABOR COST VARIATIONS

Spoilage variation

Cost, had spoilage been as expected:			
Expected spoilage (Fig. 18)	107		
Actual effectiveness (Fig. 18)	×108.5		
Actual pay rates (Fig. 12)	×106	123.06	
Actual cost (Fig. 12)		120.	
Decrease through spoilage variation		3.06	$413

(Standard cost = $13,500; Fig. 8)

Had spoilage taken place at the rate expected, while the other variations remained, the actual cost ratio would have been 123.06. It is actually 120. This is lower by 3.06 and is so only because the actual spoilage was less than expected. 3.06% of standard cost is $413, the amount of the saving in actual cost. In other words, this is the acutal cost of the products which were not spoiled as expected.

This variation is part of the time variation, which previously was found to disclose an increase in cost of $347. Consequently, there must have been a corresponding decrease in man effectiveness:

FIGURE 20

ANALYSIS OF LABOR COST VARIATIONS

Effectiveness variation

Cost, had spoilage been as expected (Fig. 19)	123.06	
Cost, had both spoilage and effectiveness been as expected; i.e., expected time at actual rates (Fig. 13)	117.43	
Increase through effectiveness variation	5.63	$760

(Standard cost = $13,500; Fig. 8)

It is known that if spoilage had been as expected, cost would have stood at a ratio of 123.06. It is also known that if time had been as expected, the cost would have stood at a ratio of 117.43 (Fig. 13.). The former ratio excludes the spoilage variation, the

latter excludes both spoilage and effectiveness. Consequently the difference must be caused by a variation in effectiveness. It amounts to 5.63% of standard cost, or $760 increase in cost.

Assembling all the figures produces the following complete analysis of the labor cost variations, accounting in full for the difference between actual cost and expected cost:

FIGURE 21

ANALYSIS OF LABOR COST VARIATIONS

Standard cost	*Expected cost*	*Actual cost*	*Variation*
$13,500	$15,255	$16,200	$945

Ratios to standard			*Variations*	
Actual	*Expected*	*Factors*	*Increase*	%
104.3	107	Spoilage	$413	3.06 (d)
108.5	103.5	Effectiveness (c)	760	5.63
113.2	110.8	Time	347	2.57
106.	102.	Hourly pay	598	4.43 (d)
120.	113.	Cost	$945	7.00%
117.43	117.43	Cost, had time not varied (110.8 × 106)		
2.57	4.43	Variations		
123.06	123.06	Cost, had spoilage not varied (107 × 108.5 × 106)		
3.06	5.63	Variations		

(c) Man-hours; effectiveness = 100 ÷ 108.5 = 92.2

(d) Check: 104.3 − 107 = 2.7 × 107 × 106 = 3.06
106 − 102 = 4.0 × 110.8 = 4.43

The same condition will be found, in an incidental variation, in the spoilage-effectiveness calculation as existed in the time-hourly pay calculation. The spoilage gain is shown at actual cost, but the effectiveness loss is shown at actual cost for the task; that is to say, at actual cost for spoiled work at the expected level of 107. This is greater than would be saved if the effectiveness variation were eliminated, because the spoilage loss actually is lower. If it is desired to compute how much actually would be saved were the

effectiveness variation eliminated but the favorable spoilage variation retained, it can be done by reducing the loss of $760 from the level 107 to the level 104.3 ($760 ÷ 107 × 104.3). The amount will be found to be $741.

The labor cost variation has now been fully analyzed and explained. It will be understood that the figures may be assembled in any desired arrangement and may refer to a product, a product class, a department or an entire factory. The arrangement in which the figures are to be presented is entirely optional and will be that which is found most useful in each case.

MAN EFFECTIVENESS VS. PAY RATE

One of the interesting comparisons possible by means of ratios to standard for related variations is that between man effectiveness and average hourly earnings. On the basis of the figures which were used in the foregoing examples, this comparison is as follows:

FIGURE 22

Actual wage level (labor cost ratio before spoilage) (Fig. 17)	115
Expected wage level (man hours 103.5) × hourly pay 102 (Fig. 21)	105.6

The labor cost ratio before spoiled work is deducted shows the relation between performance and rate of pay. In the assumed figures this relation actually is 115. It is so because wages were paid at the rate of 106 when performance, i.e., man effectiveness, was only 92.2. (Man effectiveness, 92.2, is the reciprocal of the hour ratio 108.5.) Thus it is made plain that something is out of line, for it is not equitable for the rate of pay to deviate much from effectiveness; in theory at least they should be equal. In practice, however, they will often not be equal because there will be time variations influencing effectiveness, which are beyond the control of the individual worker, and, on the other hand, there will be rate allowances and adjustments irrespective of effectiveness. So the expected wage level may be something above 100; in the example it is 105.6, which then becomes the measure for comparison with the actual wage level, 115.

It is of aid to obtain index characters like these in order to be assured that the basis of payment of wages is sound. The proportion between effectiveness and pay will vary with the system of wage payment. Under the piece-work system, with no guaranteed minimum earnings, the rate of pay will always equal man effectiveness (before accounting for spoiled work); with a minimum guarantee, the rate of pay will equal effectiveness if production is at or above standard. If production is below standard, the rate of pay will be greater than man effectiveness. This will also occur under premium systems of wage payment, irrespective of the type of system. When wages are paid on the hourly system without incentive, the rate of pay will be equivalent to the rate of effectiveness only when production is at standard with no change in wage scale. It will be greater than effectiveness when production is below standard and lower than effectiveness when production is above standard.

These proportions can be brought out best by some examples:

FIGURE 23

Base rate 60 c. per hour.
Pieces per hour, 25; hours per C, 4.
Standard labor rate — $3.20 per C = 80 c. per hour.

CASE I—PRODUCTION AT STANDARD

Production: 75 pieces. Time: 4 hours. Pay: $2.40

	Actual	*Standard*	*Ratio*		
Labor cost	2.40	2.40	100		
Hours	4	3	133	Effectiveness	75
Pay	.60	.80	75	Wage level	100

In case I, output is assumed to be exactly at standard. Pay will then also be at standard, whether under the piece-work, day-work or premium system. As is the case under many incentive plans, the standard is set at a level that can be reached by the ordinary worker, usually 75%. The figures show that with production precisely at standard, i.e., man effectiveness at 75, the rate of pay is 75, giving an equal wage level.

CASE II—PRODUCTION BELOW STANDARD

Production: 60 pieces. Time: 4 hours. Pay: (base rate) $2.40

	Actual	*Standard*	*Ratio*		
Labor cost	$2.40	1.92	125		
Hours	4	2.4	166	Effectiveness	60
Pay	.60	.80	75	Wage level	125

In case II, production is assumed to be below standard. Pay is computed at the base rate or minimum guaranteed hourly wage. In these circumstances, man effectiveness is 60, whereas the rate of pay is 75, causing the wage level to be 125. The proportion between rate of pay and effectiveness has been disturbed because performance has not reached standard.

CASE III—PRODUCTION ABOVE STANDARD

Production: 125 pieces. Time: 4 hours. Pay: (piece work) $4.00

	Actual	*Standard*	*Ratio*		
Labor cost	$4.00	4.00	100		
Hours	4	5	80	Effectiveness	125
Pay	1.00	.80	125	Wage level	100

In case III, production is above standard and effectiveness is therefore high, namely 125. Pay on a straight piece-work basis is correspondingly high, at the rate of 125. The rate of pay is equal to the rate of effectiveness, showing that the standard proportions have been maintained.

CASE IV—PRODUCTION ABOVE STANDARD—PREMIUM PLAN

Production: 125 pieces. Time: 4 hours. Pay: (premium) $3.60

	Actual	*Standard*	*Ratio*			
Labor cost	$3.60	4.00	90	} 100		
Premium fund	.40		10			
	$4.00					
Hours	4	5	80		Effectiveness	125
Pay	.90	.80	112.5	} 125	Wage level	90
	.10		12.5			

In case IV, production is again assumed to be above standard, but wages are computed under a premium system, assuming that on all production above standard the worker receives three-quarters of the standard pay, while one-quarter is put into a fund for distribution ultimately to foremen and indirect workers. The result then is that man effectiveness is 125, but the pay rate is 112.5, and the wage level is relatively 90.

Under systems of premium wage payment having other peculiar features or differentials for the calculation of bonus at various levels of effectiveness, the proportion between effectiveness and pay rates will vary accordingly. The comparison in ratios will have to be made with the particular conditions in mind.

It will be observed that in the foregoing examples of Fig. 23, the wage level ratio is always the same as the labor cost ratio. This will not occur in actual practice when the figures are prepared for a group or a department and spoiled work is taken into account. Then the wage level is represented by the labor cost ratio before spoilage (Fig. 17).

CHAPTER V

ANALYSIS OF BURDEN COST VARIATIONS

Burden Cost Variation

The procedure as to burden is to absorb in current costs only an amount equivalent to current operations, taking the number of hours run at normal burden rates set up in the budget for operations at normal capacity. The difference between the amount so derived, if the actual expenses are greater, is carried to profit-and-loss as unabsorbed burden. As was pointed out in a preceding chapter, the primary reason for doing this is to avoid inflating costs when operating conditions are below normal, for the variation from this cause is not properly a part of cost of products made under these conditions. In the converse situation, it is equally undesirable to reduce costs when operations are above normal, and the variation from this cause is not an average or usual condition from which the cost of products then being made should benefit. Over-absorbed burden, if the actual is less than the amount absorbed at normal rates, is likewise carried to profit-and-loss and ultimately is applied commensurately to cost of goods sold and on hand.

This procedure also permits interesting comparisons and the segregation of variations that would otherwise be hidden. In the following examples it is assumed, for sake of illustration of comparisons as to machine effectiveness, that burden is absorbed on the basis of machine-hour rates.

FIGURE 24

ANALYSIS OF BURDEN COST VARIATIONS

Burden absorbed

	Actual	*Standard*	*Ratios*
Burden absorbed in costs, at normal machine rates for the hours run	$20,218		
Production, at standard burden cost (including spoiled work)		18,900	107
Machine effectiveness (S:A)			93.4
Less—spoiled work, at standard burden cost		800	
Standard burden, net		$18,100	
Burden cost ratio			111.7
Spoilage ratio (111.7 ÷ 107)		104.4	

Standard burden is based upon units of production, computed at the standard burden cost per unit established in the standard-cost files. (The standard burden cost per unit is derived in the first instance from the normal burden budget, in which the total normal burden is reduced to rates per machine hour; then the standard units of production per hour, divided into the standard burden per machine hour, will yield the standard burden per unit of production).

The burden to be absorbed in costs, however, is computed by extending the actual machine hours at the normal machine-hour burden rates. The aggregate is burden calculated at normal rates, but for actual time, whereas standard burden is on the basis of normal rates for standard time.

In Fig. 24 the burden absorbed in costs on the basis of the actual machine time stands at a ratio of 107 to the aggregate standard burden derived by pricing production at standard unit burden costs. Inasmuch as the basic rate per hour at which burden is computed is identical in both cases, the ratio represents the relation between actual and standard machine time. The reciprocal of this ratio indicates machine effectiveness 93.4.

The calculation includes the effect of performing operations on machines other than contemplated in setting the standard costs.

Thus, if a larger machine were used, entailing a higher burden rate, the effect would be a greater absorption and an increased operating ratio, which would bring about a correspondingly decreased machine-effectiveness ratio. The use of another machine would also probably cause a difference in time for performing the operation, which would likewise get into the variation. If the alternative machine took less time, it would offset the higher burden rate; if it took more time as well as a higher rate, it would aggravate the variation. Ordinarily it is not necessary to separate this cause so as to isolate the running effectiveness of machines which actually were operated. When it is desirable to do so, it can be done, but an extra calculation is necessary in computing burden variations in order to ascertain the standard burden for the machines which were used, as well as the standard burden for the standard machines.

Having ascertained the burden cost ratio, it is possible to compare current results with past performances and to bring out the trend, in the same way as with labor. It is also possible to express the difference between actual and expected results.

FIGURE 25

ANALYSIS OF BURDEN COST VARIATIONS

Total variation

Expected burden cost ratio	110.8	
Actual burden cost ratio	111.7	
Variation, increase in cost	.9	*$163*

Assuming that based on experience a burden cost ratio of 110.8 is expected, the variation is equal to .9% of the standard burden, $18,100; the net variation, therefore, is $163 increase in cost. It will be evident from the data in Fig. 24 that this result has been brought about as the combination of two variations, namely, spoiled work and machine effectiveness. A variation in rates is absent in this calculation because burden is absorbed in costs at fixed normal rates. (There may be a rate variation on account of using alternative machines, as was stated previously. It will suffice for ordinary

requirements, however, to regard this as a machine-effectiveness variation.)

The results can be analyzed as follows:

FIGURE 26

ANALYSIS OF BURDEN COST VARIATIONS

Standard burden	*Expected cost*	*Burden absorbed in actual cost*	*Burden cost variation*
$18,100	$20,055	$20,218	$163

Ratios to Standard			*Variations*	
Actual	*Expected*	*Factors*	*Increase*	%
104.4	107	Spoilage	$505	2.79 (a)
107	103.5	Machine effectiveness (b)	668	3.69
111.7	110.8	Cost	$163	.9
114.49	114.49	Cost, had spoilage not varied	(107 × 107)	
2.79	3.69	Variations		

(a) Check: 104.4 − 107 = 2.6 × 107 = 2.78
(b) Machine hours; effectiveness = 100 ÷ 107 = 93.4

A saving is disclosed through a reduction in spoiled-work losses which corresponds to the similar saving in labor cost. It is offset and exceeded by a decline in machine effectiveness, so that the net result is a small increase in cost. As was the case in the analysis of labor cost variations, the spoilage loss is computed at actual cost (that is, at absorbed normal burden) while the machine-effectiveness loss is for the task, namely, for expected spoilage. If it is desired to compute the amount which would be saved if the decline in machine effectiveness were eliminated, while the saving in spoilage were retained, it can be done by reducing the machine effectiveness loss of $668 from the level of 107 to the level 104.4. This would produce the amount $652 ($668 ÷ 107 × 104.4).

The analysis of burden-cost variations may be made by departments, machine groups, product classes, or factory units or any combination of them that may be useful.

A separate analysis is to be made of the variations which result in unabsorbed burden.

UNABSORBED BURDEN

The analysis of the variations in burden cost based on normal rates naturally will not disclose the further variations resulting in the unabsorbed burden. The amount of unabsorbed burden is the difference between actual expenses and the burden absorbed in costs:

FIGURE 27

ANALYSIS OF UNABSORBED BURDEN

Burden unabsorbed

		Controllable expenses	*Fixed charges*
Actual controllable expenses		$17,100	
Actual fixed expenses			7,695
Burden absorbed in costs (Fig. 26)	$20,218		
Contained in burden rates:			
Controllable expenses	70%	14,153	
Fixed expenses	30%		6,065
Unabsorbed burden	$4,577	2,947	1,630

The actual expenses are best kept separate as to those which are controllable by foremen, on the one hand, and those which are not so controllable but consist of fixed expenses or arbitrary plant apportionments, on the other hand. In the normal burden budget, the controllable expenses and the fixed expenses for a department or production center are in ascertainable proportions. That is to say, the percentage of each to the total burden is definite and constant in all the burden rates within the department. Therefore, it is possible to split the burden absorbed in costs through the normal burden rates by means of these percentages, so as to obtain separate amounts for the absorbed controllable expenses and absorbed fixed expenses. Unabsorbed burden can then be shown separately for each classification.

The separation is useful, not only because the expenses are different in nature and in directions of responsibility, which will cause them to vary disproportionately, but also because the necessity of monthly distributions and redistributions of fixed charges between operating departments is eliminated. Once introduced in the normal burden budget and burden rates in the proper distribution, it is no longer necessary to sub-divide and spread the actual fixed expenses over the manufacturing departments. It is indeed clearer not to sub-divide them, but to collect fixed expenses in nominal accounts, suitably classified for identification and control.

The unabsorbed burden can be further divided into the amounts arising through two variations, namely, (1) that which is due to spending more or less, and (2) that which is due to running the plant more or less. The first brings out the rate of spending, and the second brings out the rate of use of available capacity. The figures are broken down as follows:

FIGURE 28

ANALYSIS OF UNABSORBED BURDEN
AS BETWEEN ACTUAL RESULTS AND CAPACITY

(*Loss*)

	Amount	*Ratio to budget*	*Amount*
Normal burden (budget at capacity)	$27,000		
Fixed expenses—30%	8,100		
Controllable expenses	18,900	100.0	$18,900
Burden absorbed in costs—controllable expenses (Fig. 27)	14,153	74.9	
Operating variation (degree of capacity unused)	4,747	25.1 (a)	
Actual controllable expenses (Fig. 27)			17,100
Spending variation (in relation to budget)	1,800	9.5 (a)	1,800
Net unabsorbed burden—controllable expenses (Fig. 27)	2,947	15.6 (a)	

(*Loss*)

	Amount	*Ratio to budget*	*Amount*
Fixed expenses:			
Budget (above)		100.0	$8,100
Absorbed (Fig. 27)		74.9	6,065
Operating variation		25.1 (c)	$2,035 (b)
Spent (Fig. 27)		95.0	7,695
Spending variation		5.0 (c)	405 (b)
Budget		100.0	$8,100
Net unabsorbed	1,630 (b)	20.1 (c)	
Total unabsorbed burden	$4,577		

It will be observed that in the foregoing calculations fixed expenses are included in the normal rates at which burden is absorbed in costs, but they are separated in the subsequent analysis, in order that the variations in controllable expenses may be set out. The results, summarized, are:

FIGURE 29

UNABSORBED BURDEN

	Controllable expenses		*Fixed expenses*
(1) Spending variation:			
Budget	$18,900		8,100
Actual expense	17,100		7,695
Gain	1,800		405
(2) Operation variation:			
Budget	$18,900	8,100	
Burden absorbed	14,153	6,065	
Loss	4,747		2,035
Net unabsorbed	$2,947		1,630

Expense Index

While no general rule can be laid down as to what the proportion between running and spending should be, standards for these items can be set up from experience. For the sake of illustration, it may be assumed that the following collateral ratios are fair standards:

Operating level	*Spending level*
90	95
88	94
86	93
84	92
80	90
76	88
74	87
70	85
	etc.

The scale, of course, is arbitrary—different relationships will have to be set up for departments with different operating conditions—but the figures will serve for the present purpose.

These are then the following data:

Figure 30

Operating level (Fig. 28)	74.9
Nearest standard spending level	87
Controllable expenses:	
Actual spending level (Fig. 28)	90.5
Expense index (90.5 ÷ 87)	104
Fixed expenses:	
Actual spending level (Fig. 28)	95
Expense index (95 ÷ 87)	109.2

The relationship between the actual spending ratio and the one which is appropriate to the current operating level can be expressed as an expense index. Such index characters will immediately indicate expenditures which are out of line with the expected proportions, even though operating activity may fluctuate. In the example (Fig. 30) it is evident that the spending rate for fixed expenses is disproportionate to current operating activity, while the index for controllable expenses is closer to what it should be, although still excessive. The conditions can be brought out by further analysis of the variations.

Variations From the Expected Unabsorbed Burden

In the preceding analysis of unabsorbed burden variations, the basis is the full normal operating budget. So long as operations are somewhere near normal, this analysis may suffice, but as soon as operations drop considerably from normal activity or fluctuate markedly, a further analysis is advisable in order to bring out what are the variations from what should arise under such changing conditions. It is quite possible and really simple to make such an analysis. Under modern methods of planning and production control, the operating level for each department is predetermined for at least one month or longer. The spending level appropriate to the planned operation can be set down. Thus the expected results can be established, so that actual performance can be compared with it and the variations can be analyzed:

Figure 31

ANALYSIS OF UNABSORBED BURDEN AS BETWEEN ACTUAL AND EXPECTED RESULTS

	Expected results (per operating schedule)	*Actual results*	*Variation*	*Expense index*
Controllable	$1,890	2,947	1,057	104 (a)
Fixed	810	1,630	820	109.2 (b)
Total	$2,700	4,577	1,877	

(a) 90.5 ÷ 87 = 104.
(b) 95 ÷ 87 = 109.2.
} Fig. 30

Ratios to budget			*Budget* $27,000		
Operating			*Controllable* 18,900	*Variations*	
schedule	*Actual*	*Expected*	*Fixed*..... 8,100	%	*Loss*
			Controllable expenses:		
90	90.5	87	Spending	3.5%	$ 660 (a-1)
80	74.9	74.9	Operating		
10		12.1		2.1	397
	15.6		Unabsorbed variation	5.6%	$1,057
			Fixed expenses:		
90	95	87	Spending	8.0	650 (a-2)
80	74.9	74.9	Operating		
10		12.1		2.1	170
	20.1		Unabsorbed variation	10.1%	$ 820

Rounded out to overcome dropped decimals in ratios:
(a-1) actually comes to $662;
(a-2) to $648.

The ratios in the column headed "operating schedule" represent the original expectations as to rate of spending and rate of operating. After the actual operations become known and it is found that the operating level is 74.9, the expected spending level must be revised accordingly. The revised ratios are shown in the column headed "expected".

The spending variation then consists of the difference between the actual and expected ratios, showing an increase of 3.5% on the budget, which amounts to $660. The operating variation has two factors in it: one of them is the failure to reach the expected operating level set down in the operating schedule and the other, which is offsetting, is the corresponding reduction in the allowable spending rate. The net difference is between the unabsorbed burden expected under the operating schedule and the unabsorbed burden expected under actual operating conditions. This amounts to 2.1% of the budget or a loss of $397.

For fixed expenses, a high spending rate is disclosed, resulting in a loss of $650. This is relatively higher than for controllable expenses, as the expense index signifies. The operating variation for fixed expenses is of course in the same proportion as for controllable expenses. The normal proportion between spending and running for fixed expenses is assumed in this illustration to be the same as for controllable expenses, but in practice it will more often be quite different, because fixed expenses can not be reduced readily or consistently with declines in operating activity.

Based upon this analysis, a recapitulaton of the figures can be made to show the amount of unabsorbed burden which is due to the existence of unused capacity and the amount which is due to excessive expenditures:

FIGURE 32

RECAPITULATION OF UNABSORBED BURDEN

	Unused capacity Loss		*Spending Variation*		*Total loss*	
	% of Budget	*Amount*	*% of Budget*	*Amount*	*% of Budget*	*Amount*
Controllable	12.1%	$2,287	3.5%	$ 660	15.6%	$2,947
Fixed	12.1	980	8.0	650	20.1	1,630
Total ..		$3,267		$1,310		$4,577

The analysis of unabsorbed burden is now complete. The figures of controllable expenses usually will be presented according to departments, while those of fixed expenses will be shown for the plant as a whole or divided according to lines of responsibility.

Some of the ratios derived in the analysis of burden variations are useful for other purposes, which should be referred to, before leaving the subject of burden analysis, while the figures are fresh in mind.

MACHINE-LABOR EFFECTIVENESS

Whenever machinery is employed in manufacturing operations, there is an ascertainable relationship between man effectiveness

and machine effectiveness. When an operation is performed by one man on one machine, this relationship is constant and the man effectiveness must be equal to the machine effectiveness. But when there are many kinds of machinery, this relationship varies. For instance, one person may run a number of machines, such as looms or automatic screw machines. Or, conversely, one machine may require a number of persons to operate it, such as a large rotary press or a paper-making machine. In operations of either sort, a machine-labor-effectiveness ratio can be found from the relation between man effectiveness and machine effectiveness:

FIGURE 33

Man effectiveness ratio (Fig. 21)	92.2	
Machine effectiveness (Fig. 24)	93.4	
Machine-labor effectiveness (92.2 ÷ 93.4)		98.6

In this example, using former figures, the man-effectiveness ratio is lower than the machine-effectiveness ratio, both computed before spoiled work has been deducted. The machine-labor effectiveness is the ratio of man effectiveness to machine effectiveness. When it is less than 100 it signifies that proportionately too many persons worked—too much man power has been applied. Had not more man-hours been used than were commensurate with the machine-hours run, man effectiveness would equal machine effectiveness. Therefore, in the present case on operations in which one person runs a number of machines, too few were run, or, on operations requiring a crew, too many were employed in the crew. If desired, the extent of this variation can be expressed separately as an element of the labor cost variation.

OUTPUT EFFECTIVENESS

A striking way of expressing the effect of increased time and spoiled work upon operating results consists of showing on operating reports the combined effect of the burden cost ratio and the existing operating level.

FIGURE 34

Operating level (Fig. 31)		74.9	
Burden cost ratio (Fig. 26)	111.7		
Output effectiveness (100 ÷ 111.7)		89.6	
Output ratio (to capacity) (74.9 × 89.6)			.67

This method of expressing the results emphasizes in the output ratio the influence of efficient production and serves to call attention to this influence more impressively than would be the case if merely the burden cost ratio, 111.7, were regarded.

BASIS FOR ABSORBING BURDEN

In the foregoing examples machine-hours and machine-hour rates have been used as the basis for absorbing burden and calculating variations in burden costs and operating effectiveness. Machine-hour rates would be employed in the majority of cases where the use of machinery is substantial and information of this nature is helpful to the management. There will be other cases, however, in which the employment of machinery is incidental or no machines are used except such as would fall in the category of tools. Then burden would be absorbed on the basis of man-hours, and the calculations as to burden in other respects would be similar. In still other cases, on account of the nature of the process or for greater facility, burden might be absorbed on a quantity basis, but only when the conditions were such that quantity was fairly representative of time, because time is the true measure of burden cost. Double production under equal conditions cuts the burden cost in half.

CHAPTER VI

ANALYSIS OF MATERIAL COST VARIATIONS

Price Variation

Analysis of the variations in material costs is made in very much the same way as the analyses of the labor cost variation and the burden cost variation, by computing the extent of the changes which have occurred in relation to basic standard costs. The factors subject to change in the case of material costs are (1) the price at which the raw material is purchased and (2) the quantity of it which is consumed. These result in a price variation and a use variation, respectively. They are essentially of the same nature as the rate variation and the effectiveness variation in the preceding calculations; the price variation on materials indicates the rate of expenditure, and the use variation, the effectiveness in the consumption of materials. There is one difference, however, in the use variation from the labor and burden effectiveness variation, in that scrap may be recovered, which must be taken into account at the reclaim value of the recovered scrap, whereas in the cases of labor and burden there is no factor of recovery involved in effectiveness losses.

The price variation is obviously the difference between the actual cost of material used and its standard cost, computed at basic standard material prices:

Figure 35

ANALYSIS OF MATERIAL COST VARIATIONS

Price variation

Material used:	
Actual cost	$19,605
Standard cost	20,637
Material price ratio	95

The ratio of the actual cost of material to the corresponding standard cost is the measure of the price paid, before any other factors have entered into the calculation. In the example the actual cost is below standard, showing a price ratio of 95.

Having isolated the price variation, the next step in analysis is to relate the actual material cost to the standard cost of production, so as to ascertain the over-all material cost ratio. It will then be possible to determine the use variation, inasmuch as the material cost ratio is composed of the price and the use variations; i.e., price times use equals cost.

In making the calculation, scrap recovered must be included. The material used is seldom entirely consumed in manufacturing operations. There is usually a residue recoverable as scrap or waste. The difference between the original cost of the recovered material and its scrap value is a part of material cost and may range from a small percentage to one-third or even one-half the original quantity, according to the kind of material and the product.

Figure 36

ANALYSIS OF MATERIAL COST VARIATIONS

Use variation

	Actual	*Standard*	*Ratio*
Material used (Fig. 35)	$19,605	20,637	95
Scrap recovered—64,224 lbs.	1,526	1,606	95
Material used, net	$18,079	19,031	
Production: net good product		$18,000	
Material cost ratio			100.44
Material use ratio (100.4 ÷ 95)			105.73

Scrap recovered is taken into account at a fixed standard price and at a corresponding actual value obtained by applying the price ratio. While the value thus obtained may not be the actual realizable value, it is simpler to avoid the introduction of another variation in this analysis by taking scrap into account at a different market level. When scrap is actually sold, any difference arising between

the selling price and the reclaim value at which it has been set up can be treated as an incidental gain or loss on sale of scrap. Normally such differences are likely to be negligible.

When the total standard cost of production is derived by pricing net good product at the basic standard material cost established in advance, the material cost ratio can be obtained. In Fig. 36, the standard cost of production is $18,000, the net actual material cost for which is $18,079, indicating a cost ratio of 100.44.

Had the quantity and kinds of material used been precisely in accordance with the specifications set down in the basic standard costs, and had there been no loss through spoilage, the material cost ratio would have been 95, the price level at which the material was obtained. The material cost ratio being higher than 95, a use variation is disclosed, which arises from using different material or using more material or producing more scrap or spoiling more product; in fact, all these factors may have varied from the specifications. Sometimes there is an invisible loss, or shrinkage, also, which comes about when materials are used, through evaporation, reduction or some other form of dissipation, leaving no residue recoverable as scrap. Variations may and often do occur in such shrinkages and this in such cases is another factor in the use variation.

Material Use Variation

The material use variation is susceptible of further analysis to ascertain the extent to which each of the factors present was operative. The manner in which this analysis is made, however, will differ according to the circumstances: the nature of the material, the factors which may vary and the data about them which may be obtainable. It is not possible to outline a general procedure that can be followed in all cases, but an example can be given of an analysis based upon certain premises. Let us assume a product in which there is some shrinkage in raw material, in the manufacture of which a certain proportion of scrap is entailed and on which spoilage may occur. It is necessary to have in mind, when establishing the basic standard material costs, the manner in which it is desired to analyze material use variations, in order that all the

needed data for subsequent calculations shall be available. The basic standard cost data for the hypothetical product would be set down as follows:

Figure 37

BASIC STANDARD MATERIAL COST

		Pounds	*Price per lb.*	*Standard cost per 100 pieces*
A—Good product:				
Gross material		100	8c	$8.00
Scrap		20	2½	.50
Shrinkage		5	—	—
Net		75	10c	$7.50
B—Scrap loss:				
Scrap		20	5½c	$1.10
C—Spoiled work:				
Recovery				
Net material	75			
Scrap	20	95	2½c	$2.375
Loss (from gross material cost)				5.625

The net weight of the product is 75 lbs. per 100 pieces, for which 100 lbs. of gross material are required, 20 lbs. being recoverable as scrap and 5 lbs. disappearing as shrinkage. The scrap loss per 100 pieces of product is computed at the difference between the initial cost of the material and its reclaim value. The spoiled work loss is computed similarly, except that the shrinkage which runs with it is included in the loss of $5.625 per 100 pieces.

The basic standard cost of net good production, $18,000 (Fig. 36) used as the basis for computing the material cost ratio, is obtained by pricing the pieces produced at the basic unit standard cost of $7.50 per 100. The material cost ratio discloses a use variation of

105.73 (100.44 ÷ 95) (Fig. 36), which it is the purpose to analyze to find out how much is due, respectively, to spoiled work, scrap and shrinkage variations from standard:

FIGURE 38

ANALYSIS OF MATERIAL COST VARIATIONS

Composition of use variation

Standard material cost $18,000		*Standard*
A		
Use ratio (Fig. 36)	105.73	
Variation	5.73	$1,031
Spoiled work loss (at basic standard spoiled work "loss" prices—Fig. 37c)	4.50	810
Excess scrap and shrinkage loss—remainder	1.23	221
B		
Total scrap reported (Fig. 36) (lbs.)	64,224	
Spoiled work, at standard weight of material	13,680	
Remainder, plain scrap	50,544	
Standard scrap loss for actual good production (— pcs. at — lbs. per 100)	48,000	
Scrap ratio (weight)	105.3	
Excess scrap	5.3	
Standard scrap loss (in dollars) for actual good production (— pcs. at $— per 100)	$2,640	
Excess scrap loss (5.3 × $2,640)		140
Remainder, excess shrinkage		$ 81

The analysis is divided into two parts, A and B, because it will not always be practicable to obtain the operating data necessary to make calculation B, whereas calculation A will usually be quite feasible.

It is known that there are three factors in which variations may have taken place, namely, spoiled work, scrap and shrinkage. The loss arising from spoiled work can be ascertained by obtaining production reports and extending the number of pieces spoiled at the basic standard spoiled work loss ($5.625 per 100, Fig. 37). In the

example, this loss amounts to $810 of the total use variation of $1,031. The remainder, $221, must be the consequence of excessive scrap and shrinkage combined.

The combined scrap and shrinkage variation can be broken down so as to disclose the excess of each, when it is feasible to obtain data about:

Standard weight of spoiled work.
Standard weight of scrap for net good production.
Standard scrap loss for net good production.

In Fig. 38, the deduction of the standard weight of spoiled work from the total scrap recovered gives the weight of scrap produced from causes other than the spoilage of product, namely, 50,544 lbs. The standard weight of scrap that should have been produced on the net good production, according to the basic standard specifications, is 48,000 lbs. A scrap ratio of 105.3 exists; that is, 5.3% more scrap than standard was produced. The standard scrap loss running with net good production based on the basic standard specifications (at $1.10 per 100 pieces, Fig. 37) amounts to $2,640. The excess scrap loss, therefore, is $140. The excess shrinkage is the remainder of the use variation, or $81.

As already stated, this method of analyzing the material use variation will not fit all conditions; it will, however, be suitable for conditions comparable with the premises of the example. But the illustration will suffice to bring out the principles involved, and it will be understood that calculations of this character can be based on other premises, depending entirely upon the material, the manufacturing processes and the extent of refinement in analysis desired.

MATERIAL USE—SUBSTITUTION

There is another factor of variation which has not been isolated in the foregoing calculations. The material used may not be exactly the size, kind or grade specified in the basic standard costs. Then the material cost ratio is affected, because the actual material cost is on a basis different from the standard material cost for net good

production. The variation present finds its way into the use variation, inasmuch as (in Fig. 36) the price variation alone is eliminated. Should it be desired to ascertain how much of the use variation may arise from this cause, it would be necessary to compute two standard costs for materials used, one for the materials actually used and another for the materials that should have been used. Ordinarily this is a refinement in analysis that is not warranted by practical benefit. It will usually be satisfactory to permit any variation from this cause to be merged with the use variation, where indeed it belongs, because any deviations from specifications in the nature of materials used will probably result in a variation in the quantity required.

Analysis of Material Cost Variations From the Expected

The basic standard costs, which are the foundation for analysis of material cost variations, do not represent the expectations as to performance. Thus far the discussion has been concerned with theory of the analysis, but the object really is to ascertain how much actual costs differed from expected costs, and why:

Figure 39

ANALYSIS OF MATERIAL COST VARIATIONS

Standard cost	*Expected cost*	*Actual cost*	*Variation*
$18,000	$19,080	$18,079	$1,001

Ratios to standard			*Variations*	
Actual	*Expected*	*Factors*	*Increase*	%
104.50	107.66	Spoilage	$ 540	3.00 (a)
+1.23	+0.50	Scrap and shrinkage	124	.69 (a)
105.73	108.16	Use	416	2.31
95	98	Price	585	3.25
100.44	106	Cost	$1,001	5.56
102.75	102.75	Cost, had use not varied (108.16 × 95)		
2.31	3.25	Variations		

(a) Difference between actual expected ratios, taken at 95; check: 3.00 — .69 = 2.31.

FIGURE 40

DETAILS SUPPORTING ANALYSIS OF MATERIAL COST VARIATIONS (FIGURES 35 TO 38 INCLUSIVE)

Operations	*Pounds — Net material*	*Scrap*	*Shrinkage*	*Gross material*	*Price*	*Cost*
ACTUAL:						
Good product—240,000 pieces ..	180,000	50,400	12,960	243,360	$.076	$18,495
Spoilage—14,400 pieces	10,800	3,024	778	14,602	.076	1,110
Gross material			13,738	257,962	.076	19,605
Scrap recovery	10,800	53,424	—	64,224	.02–⅜	1,526
Material cost, good product ...						$18,079
STANDARD (for actual production):						
Good product—240,000 pieces ..	180,000	48,000	12,000	240,000	$.08	19,200
Spoilage—14,400 pieces	10.800	2,880	720	14,400	.08	1,152
Gross material			12,720	254,400	.08	20,352
Scrap recovery	10,800	50,880	—	61,680	.025	1,542
Material cost, good product ...						18,810
Basic standard cost—240,000 pieces @ $7.50 per 100.....						18,000
Spoilage loss (@ standard) 14,400 pieces @ $5.625 per 100						$810
EXPECTED (for actual production):						
Good product—240,000 pieces ..	180,000	48,000	13,014	241,014	$.0784	18,895
Spoilage—24,532 pieces	18,400	4,906	1,330	24,636	.0784	1,932
Gross material			14,344	265,650	.0784	20,827
Scrap recovery	18,400	52,906	—	71,306	.0245	1,747
Material cost, good product ...						$19,080

I—Variations in actual from standard

Excess scrap loss—2,544 @ $.08		$ 204
Less recovery @ $.025		64
		140
Spoilage loss—14,400 @ $.08	$1,152	
Less scrap recovery—13,680 @ $.025	342	810
Excess shrinkage—1,018 @ $.08		81
		1,031
Basic standard cost		18,000
Standard cost of gross production		19,031
Actual cost		18,079
Price variations:		
257,962 @ $.004	1,032	
64,224 @ $.00125	80	952

II—Variations in actual from expected

Excess scrap loss:	*Pounds*	
Increase in scrap recovery	518	
Add standard scrap on decline in spoiled work—10,132 pieces @ 20 lbs. per C.....	2,026	
	2,544	
2,544 @ $.076		193
Less recovery @ $.02⅜		60
		$ 133
Spoilage loss (decrease):		
Gross material 10,132 pieces @ 100 lbs. per C.....	10,132	
Recovery @ 95 lbs.....	9,626	
10,132 @ $.076		770
9,626 @ $.02⅜		229
		$541
		408
Shrinkage (decrease):		
Actual decrease	606	
Standard decrease on 10,132 pcs. spoiled work @ 5 lbs...	507	
	99	
Net decrease—99 @ $.076		8
		416
Price variation:	*Dollars*	
265,650 @ $.024	638	
71,306 @ $.0075	53	585
Total variation:		
Expected cost	19,080	
Actual cost	18,079	1,001

The nature of the product is such that a high ratio of spoilage is normal. Therefore it is apparent that, although material use is above standard, it is below expectation and a saving actually was made through reduced spoilage of product. The price variation also shows a saving, notwithstanding that some price decline was expected.

The analysis of material cost variations is most usefully presented by materials or material classes. It can also be recapitulated by products or product classes if desired, although for operating purposes this arrangement has less meaning. The effect of the material cost variations is of course introduced eventually into the cost of products placed in finished stock or sold.

For the benefit of the reader who may wish to follow through in detail the transactions which have been analyzed, complete figures underlying the material cost variations illustrated are given in Fig. 40, assuming one product for which the basic standard material costs are shown in Fig. 37. The variations displayed, resulting from calculating at length the changes which took place, agree with the amounts obtained by the analyses based upon ratios (Figs. 38, 39). At the same time, the appreciable saving in effort in the use of the ratios becomes apparent by comparison.

Loss on Seconds

In the manufacture of certain products, it is a normal incident for a percentage to be imperfect or to be in some way inferior to the quality established for the regular product, so that it is necessary to sell them at a discount from regular selling prices. The production and sale of seconds is a regular part of the manufacture of such products as rugs, hosiery and golf balls, for example. It is cheaper to sell the seconds at a discount than it would be to reprocess them in order to improve the quality, or it may be impracticable to improve it. Strictly regarded, the loss ensues from the reduced market value, because the cost of manufacture is substantially the same for firsts and seconds. Relatively, however, the loss is an essential part of the cost of manufacture of firsts, inasmuch as it arises therefrom. The manufacture of seconds is not an object. Therefore, seconds should be carried at a commensurately

reduced cost, and the difference between the cost of seconds and their reduced cost is to be absorbed in the cost of firsts.

This adjustment is made by deducting from the total cost of production the valuation placed on seconds produced, under "actual", and the full standard cost of firsts therefor, under "standard". The effect of this is to express in the cost ratio applying to firsts the amount of the loss occurring from the change in classification of seconds.

In valuing seconds the question comes up whether their cost shall be set at a level that will afford a profit upon subsequent sale or at a level below sale value only sufficient to cover marketing costs, showing no profit. The conservative course is to carry seconds at a level that will afford the regular or at least a reasonable profit upon sale. It is open to the objection, as a matter of principle, that this procedure results in introducing an element of profit (the expected profit on seconds produced) into the cost of firsts, inflating costs to this extent. As a practical matter, however, the difference between this procedure and one expecting neither profit nor loss on seconds is ordinarily not of great consequence, so long as the procedure adopted is followed consistently.

The adjustment for seconds is made as follows:

FIGURE 41

	Actual	*Standard*	*Ratio*
Labor cost	$16,200	13,500	120
Burden cost	20,218	18,100	111.7
Material cost	18,079	18,000	100.4
Total cost	54,497	49,600	109.9
Seconds produced (at standard cost of firsts, but at valuation of seconds under "actual")	4,128	10,320	40
	$50,369	39,280	128.2
Seconds loss	$ 7,212		18.4

In the foregoing example, 20.8% of production is classified as seconds and is valued under actual costs at an amount set with regard to its prevailing market value. The valuation may fluctuate,

but it will usually run with the market values of the primary product (in this respect differing from by-products, on which the values of derivatives may vary differently from the main product or from each other).

The loss on seconds which is absorbed in the cost of firsts in these figures is $7,212. It can be computed by applying to the total net standard cost the ratio which is the difference between the cost ratio after adjustment and the one before; in this case 18.4% (18.36). Expressed in detail, the transaction is as follows:

Standard cost of seconds produced	$10,320
Cost ratio	109.9
Actual cost of seconds	11,340
Value	4,128
Loss on seconds	$ 7,212

Analysis of the variations in loss on seconds between actual and expected results can be based upon the standard costs. Three factors of change exist, namely, manufacturing cost, reclaim value, and quantity produced. Obviously these will vary independently. The analysis is made as follows:

FIGURE 42

ANALYSIS OF VARIATIONS IN LOSS ON SECONDS

Actual results	*Expected results*	*Factors*	*Variations* *Ratio*	*Variations* *Amount (Loss)*
20.8%	25%	Production of seconds		
$10,320	$12,400	Standard cost, seconds		
9.9	9.7	Cost variation	0.2	$ 22
60	50	Value variation	10	1,032
69.9	59.7	Depreciation	10.2	$1,054
		Quantity variation $2,080 @ 59.7 (decrease)		1,241
$ 7,212	$ 7,399	Total variation, gain		$ 187

Actual costs of production stand at a ratio of 109.9 (Fig. 41), whereas expected costs, on the basis of the figures used in preceding examples, would result in the ratio 109.7 (Fig. 43). The cost variation on the seconds produced is, therefore, 0.2% of standard cost. The variation in reclaim value is based on an expected recovery of 50%. A corresponding loss of 50% of standard costs will run with seconds. The actual loss is 60%, inasmuch as the valuation of production is at 40% (Fig. 41). The variation is 10%.

The quantity variation shows a gain over expectations. A normal production of 25% is expected, whereas the actual in the example is 20.8%. This results in a saving through reduction in the percentage of seconds produced, the effect of which upon the variation in loss on seconds must be computed at the expected loss ratio, 59.7. In other words, the loss was expected to be 25% in quantity (at 59.7% depreciation), whereas it was 20.8%. The variations as to actual cost and valuation loss have already been removed. The sum of these changes accounts for the net variation in loss on seconds, which is a slight gain.

CHAPTER VII

MANUFACTURING COST VARIATIONS; GRADED PRODUCTS

Material, Labor and Burden Cost Variations

The features of analysis of the variations which occur between actual and expected results, by means of basic standard costs and cost ratios, should be clear when the examples given in the preceding chapters have been studied. The principles described can be applied to any manufacturing conditions, although the application will vary to conform to existing peculiarities. But once the principles are understood, modifications in the use of the method to meet the requirements in each case will suggest themselves.

It should now be clear that the basic standard costs are used throughout in the calculations as measuring devices—as neutral characters, by means of which analysis and interpretation are facilitated as the figures are brought together. For review, the material, labor and burden cost variations which have been analyzed can be assembled on one sheet. Figure 43 illustrates a summary of manufacturing cost variations. The figures contained in it are those which have been used in the three preceding chapters. In addition the illustration provides for the display of operating ratios in prior periods, in order to show the trend for six months.

Reference was made, in earlier pages, describing the standard cost plan, to the functions of the cost ratios, which become (1) the measure of performance, (2) correction factors to be applied to standard costs in making cost calculations, (3) index characters for comparison with others in terms of common denomination, and (4) barometric symbols indicating the rate and direction of the trends. These functions will be more apparent upon examination of the assembled figures (Fig. 43). The cost ratios are the measures of

performance by comparison with the expected ratios. They focus and bring out how nearly the expectations have been accomplished, and they can be used to calculate the gains and losses which were realized.

The cost ratios become correction factors for computing the cost of any product or the cost of production or cost of sales by using them, in appropriate selection according to the purpose, to convert basic standard costs to the level of actual performance. They become index characters when used for comparing dissimilar things: for example, comparing man effectiveness with machine effectiveness in a given department, or comparing machine effectiveness in one department with machine effectiveness in other departments having dissimilar equipment. And, finally, they serve as symbols indicating the rate and direction of the trend in variations, when set down for successive periods. This is illustrated in the example (Fig. 43) by the provision for displaying ratios in prior periods.

It will also be helpful to illustrate this use of ratios (as trend ratios) by another example, notwithstanding it entails a short digression from the subject of manufacturing cost variations.

Operating Ratios to Show Trend and Relativity

It is possible to follow the same principle by establishing basic standards, in the form of budgets or expected percentages, representing expected proportions to some cardinal activity, such as sales orders received, and to develop operating ratios on many interrelated activities. In a business conducted on a large scale involving the manufacture of a great many and complex products, it is difficult to ascertain that the relationship between the issuance of manufacturing orders, the progress of production and the delivery of products under them, the accumulation of finished and semi-finished stock, the issuance of purchase orders and the amounts of factory payrolls are in correct proportion to sales orders received. All these activities must be in proper balance, else in the long run something will be askew. Manufacture will be delayed because purchase orders are behind, or inventories will pile up because manufacturing orders have been issued at too rapid a rate, or ship-

FIGURE 43

TREND SUMMARY ON MANUFACTURING COST VARIATIONS

Monthly

ANALYSIS OF SECONDS LOSS VARIATION

A	E	Factors	Amount
9.9	9.7	Cost variation	$ 22
60	50	Value variation	1,032
69.9	59.7	Depreciation	1,054
20.8	25	Quantity variation	1,241
		Variation in loss	$ 187

TOTAL COST RATIOS

					109.9	109.7

OPERATING RATIOS

PRIOR PERIODS (Actual)					THIS PERIOD	
					ACTUAL	EXPECTED
					120	113
					104.3	107
					92.2	96.6
					113.2	110.8
					106	102
					111.7	110.8
					104.4	107
					93.4	96.6
					100.4	106
					104.5	107.7
					1.2	0.5
					105.7	108.2
					95	98
					17	10
					90.5	87
					95	87
					25.1	20

SUMMARY OF VARIATIONS	STANDARD COST	ACTUAL COST	EXPECTED COST	VARIATIONS LOSS	VARIATIONS GAIN
Labor	$13,500	$16,200	$15,255	$ 945	$ ——
Burden	18,100	20,218	20,055	163	——
Material	18,000	18,079	19,080	——	1,001
Total	49,600	54,497	54,390	107	——
Unabsorbed burden		4,577	2,700	1,877	——
Total cost		59,074	57,090	1,984	——
Loss on seconds		7,212	7,399	~~187~~	187

ANALYSIS OF VARIATIONS	Loss	TOTAL VARIATION	EFFECTIVENESS VARIATIONS: SPOILED WORK	EFFECTIVENESS VARIATIONS: OTHER VARIATIONS	SPENDING VARIATIONS
Labor:		$ 945			
Spoilage			$ 413		
Man effectiveness				$ 760	
Time	$347				
Pay rates					$ 598
Burden:		163			
Spoilage			505		
Machine effectiveness				668	
Material:		1,001			
Spoilage			540		
Scrap and shrinkage				124	
Use	$416				
Price					585
Unabsorbed burden:					
Controllable expense		660			660
TOTAL OPERATING VARIATIONS		767	1,458	1,552	673
Fixed Expenses				170	650
Unused capacity	$567	1,217		397	
TOTAL COST VARIATIONS		1,984	1,458	2,119	1,323

REDUCTION

RATIO

13:1

2.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

2.0 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

1.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

PM-MGP 13″x18″
METRIC GENERAL PURPOSE TARGET
PHOTOGRAPHIC

200 mm

150 mm

100 mm

A5

A4

A3

1.0

1.1

1.25

1.4

1.6

1.8

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

1.0 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

1.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

2.0 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

2.5 mm

PRECISION℠ RESOLUTION TARGETS

Century

A&P

1303 Geneva Avenue
St. Paul, MN 55119

4.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

3.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

3.0 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

FIGURE 44

TREND RATIOS IN RELATION TO SALES ORDERS

	Activity	Budget	Description of computations		1925 Monthly average	1926 Monthly average	1927 1st quarter	1927 2nd quarter	1927 3rd quarter	1927 4th quarter	1928 Jan.	1928 Feb.	1928 Mar.	1928 April	1928 May	1928 June	1928 July	1928 Aug.	1928 Sept.	1928 Oct.	1928 Nov.	1928 Dec.
1	Sales orders received	$300 monthly	Ratio to Budget	(Mo.)	102	113	124	85	86	134	100	111										
				(Cum.)	102	113	124	104	98	107	100	106										
2	Factory stock orders placed	52% of sales orders	Ratio to Budget	(Mo.)	120	100	89	94	77	86	140	112										
				(Cum.)	120	100	89	91	87	87	140	125										
3	Factory stock orders filled	52% of sales orders	Ratio to Budget	(Mo.)	91	103	108	145	130	68	99	99										
				(Cum.)	91	103	108	123	125	107	99	99										
4	Special factory orders filled	10% of sales orders	Ratio to Budget	(Mo.)			61	83	87	64	137											
				(Cum.)			61	70	75	72	137											
5	Orders placed with iron foundry		Ratio to Budget	(Mo.)																		
				(Cum.)																		
6	Orders placed with brass foundry		Ratio to Budget	(Mo.)																		
				(Cum.)																		
7	Orders placed with Dept. No. 1		Ratio to Budget	(Mo.)																		
				(Cum.)																		
8	Orders placed with automatic machine Dept.		Ratio to Budget	(Mo.)																		
				(Cum.)																		
9	Shipments to customers	97% of sales orders	Ratio to Budget	(Mo.)	92	105	105	129	102	87	111	108										
				(Cum.)	92	105	105	115	111	103	111	109										
10	Selling expenses	8% of sales	Ratio to Budget	(Mo.)	94	89	97	130	108	77	113	104										
				(Cum.)	94	89	97	110	110	99	113	108										
11	Purchase orders and purchase contracts issued—all mat., pig iron, coke and Supp.	19% of sales orders	Ratio to Budget	(Mo.)	93	118	68	98	92	75	85	148										
				(Cum.)	93	118	68	80	83	80	85	118										
12	Purchase orders issued—brass sheet, rod, wire, tubing, anodes, etc.	2.2% of sales orders	Ratio to Budget	(Mo.)	97	114	62	82	106	66	50	86										
				(Cum.)	97	114	62	70	81	77	50	69										
13	Purchase orders issued—bronze sheet, rod, wire, tub., anodes, br. met., lib. sil.	1.2% of sales orders	Ratio to Budget	(Mo.)	88	106	93	100	67	67	100	50										
				(Cum.)	88	106	93	96	88	81	100	71										
14	Purchase orders issued—cold rolled steel	2.1% of sales orders	Ratio to Budget	(Mo.)	120	93	52	94	100	88	17	86										
				(Cum.)	120	93	52	69	79	81	17	54										
15	Purchase orders issued—all steel wire	1.4% of sales orders	Ratio to Budget	(Mo.)	121	96	47	27	82	106	75	80										
				(Cum.)	121	96	47	38	51	69	75	78										
16	Purchase orders issued—pig iron	1.3% of sales orders	Ratio to Budget	(Mo.)	81	145	50	30	70	56	375	520										
				(Cum.)	81	145	50	42	50	52	375	456										
17	Purchase orders issued—factory supplies	4% of sales orders	Ratio to Budget	(Mo.)																		
				(Cum.)																		

(All figures fictitious)

REDUCTION RATIO 12:1

PM-MGP 13″x18″
METRIC GENERAL PURPOSE TARGET
PHOTOGRAPHIC

2.0 mm ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz1234567890

1.5 mm ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz1234567890

200 mm

150 mm

100 mm

A4

A5

1.0 1.1 1.25 1.4 1.6 1.8 2.0 2.2 2.5 2.8 3.2 3.6 4.0 4.5 5.0 5.6

1.0 mm ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz1234567890

1.5 mm ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz1234567890

2.0 mm ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 1234567890

2.5 mm ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 1234567890

PRECISION℠ RESOLUTION TARGETS

Century

A&P

1303 Geneva Avenue
St. Paul, MN 55119

4.5 mm ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 1234567890

3.5 mm ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz1234567890

FIGURE 44

TREND RATIOS IN RELATION TO SALES ORDERS

	Activity	Budget	Description of computations		1925 Monthly average	1926 Monthly average	1927 1st quarter	1927 2nd quarter	1927 3rd quarter	1927 4th quarter	Jan.	Feb.	M
1	Sales orders received	$300 monthly	Ratio to Budget	(Mo.)	102	113	124	85	86	134	100	111	
				(Cum.)	102	113	124	104	98	107	100	106	
2	Factory stock orders placed	52% of sales orders	Ratio to Budget	(Mo.)	120	100	89	94	77	86	140	112	
				(Cum.)	120	100	89	91	87	87	140	125	
3	Factory stock orders filled	52% of sales orders	Ratio to Budget	(Mo.)	91	103	108	145	130	68	99	99	
				(Cum.)	91	103	108	123	125	107	99	99	
4	Special factory orders filled	10% of sales orders	Ratio to Budget	(Mo.)			61	83	87	64	137		
				(Cum.)			61	70	75	72	137		
5	Orders placed with iron foundry		Ratio to Budget	(Mo.)									
				(Cum.)									
6	Orders placed with brass foundry		Ratio to Budget	(Mo.)									
				(Cum.)									
7	Orders placed with Dept. No. 1		Ratio to Budget	(Mo.)									
				(Cum.)									
8	Orders placed with automatic machine Dept.		Ratio to Budget	(Mo.)									
				(Cum.)									
9	Shipments to customers	97% of sales orders	Ratio to Budget	(Mo.)	92	105	105	129	102	87	111	108	
				(Cum.)	92	105	105	115	111	103	111	109	
10	Selling expenses	8% of sales	Ratio to Budget	(Mo.)	94	89	97	130	108	77	113	104	
				(Cum.)	94	89	97	110	110	99	113	108	
11	Purchase orders and purchase contracts issued—all mat., pig iron, coke and Supp.	19% of sales orders	Ratio to Budget	(Mo.)	93	118	68	98	92	75	85	148	
				(Cum.)	93	118	68	80	83	80	85	118	
12	Purchase orders issued—brass sheet, rod, wire, tubing, anodes, etc.	2.2% of sales orders	Ratio to Budget	(Mo.)	97	114	62	82	106	66	50	86	
				(Cum.)	97	114	62	70	81	77	50	69	
13	Purchase orders issued—bronze sheet, rod, wire, tub., anodes, br. met., lib. sil.	1.2% of sales orders	Ratio to Budget	(Mo.)	88	106	93	100	67	67	100	50	
				(Cum.)	88	106	93	96	88	81	100	71	
14	Purchase orders issued—cold rolled steel	2.1% of sales orders	Ratio to Budget	(Mo.)	120	93	52	94	100	88	17	86	
				(Cum.)	120	93	52	69	79	81	17	54	
15	Purchase orders issued—all steel wire	1.4% of sales orders	Ratio to Budget	(Mo.)	121	96	47	27	82	106	75	80	
				(Cum.)	121	96	47	38	51	69	75	78	
16	Purchase orders issued—pig iron	1.3% of sales orders	Ratio to Budget	(Mo.)	81	145	50	30	70	56	375	520	
				(Cum.)	81	145	50	42	50	52	375	456	
17	Purchase orders issued—factory supplies	4% of sales orders	Ratio to Budget	(Mo.)									
				(Cum.)									

(All figures fictitious)

FIGURE 44

TREND RATIOS IN RELATION TO SALES ORDERS

n ns	1925 Monthly average	1926 Monthly average	1927				1928											
			1st quarter	2nd quarter	3rd quarter	4th quarter	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mo.)	102	113	124	85	86	134	100	111										
Cum.)	102	113	124	104	98	107	100	106										
Mo.)	120	100	89	94	77	86	140	112										
Cum.)	120	100	89	91	87	87	140	125										
Mo.)	91	103	108	145	130	68	99	99										
Cum.)	91	103	108	123	125	107	99	99										
Mo.)			61	83	87	64	137											
Cum.)			61	70	75	72	137											
Mo.)																		
Cum.)																		
Mo.)																		
Cum.)																		
Mo.)																		
Cum.)																		
Mo.)																		
Cum.)																		
Mo.)	92	105	105	129	102	87	111	108										
Cum.)	92	105	105	115	111	103	111	109										
Mo.)	94	89	97	130	108	77	113	104										
Cum.)	94	89	97	110	110	99	113	108										
Mo.)	93	118	68	98	92	75	85	148										
Cum.)	93	118	68	80	83	80	85	118										
Mo.)	97	114	62	82	106	66	50	86										
Cum.)	97	114	62	70	81	77	50	69										
Mo.)	88	106	93	100	67	67	100	50										
Cum.)	88	106	93	96	88	81	100	71										
Mo.)	120	93	52	94	100	88	17	86										
Cum.)	120	93	52	69	79	81	17	54										
Mo.)	121	96	47	27	82	106	75	80										
Cum.)	121	96	47	38	51	69	75	78										
Mo.)	81	145	50	30	70	56	375	520										
Cum.)	81	145	50	42	50	52	375	456										
Mo.)																		
Cum.)																		

(All figures fictitious)

REDUCTION

RATIO

13:1

2.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

2.0 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

1.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

PM-MGP 13″x18″
METRIC GENERAL PURPOSE TARGET
PHOTOGRAPHIC

200 mm

150 mm

100 mm

A4

A5

A3

1.0

1.1

1.25

1.4

1.6

1.8

1.0 mm

1.5 mm

2.0 mm

2.5 mm

PRECISION℠ RESOLUTION TARGETS

Century

A&P

1303 Geneva Avenue
St. Paul, MN 55119

4.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

3.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

3.0 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

FIGURE 44-A

TRENDS IN RELATION TO SALES ORDERS—EXPRESSED IN THOUSANDS OF DOLLARS

	Activity	Budget	Description of computations	1925 Total	1926 Total	1927 1st quarter	1927 2nd quarter	1927 3rd quarter	1927 4th quarter	1927 Total	1928 Jan.	1928 Feb.	1928 Mar.	1928 April	1928 May	1928 June	1928 July	1928 Aug.	1928 Sept.	1928 Oct.	1928 Nov.	1928 Dec.
1	Sales orders received	$300 Monthly	Actual	3,687	4,087	1,115	764	779	1,208	3,866	301	333										
			Budget	3,600	3,600	900	900	900	900	3,600	300	300										
			Over–*under*	87	487	215	*136*	*121*	308	266	1	33										
			Cumulative	87	487	215	79	*42*	266	266	1	34										
2	Factory stock orders placed	52% of sales orders	Actual	2,306	2,138	517	373	311	541	1,742	218	195										
			Budget	1,917	2,125	580	397	405	628	2,010	156	173										
			Over–*under*	389	13	*63*	*24*	*94*	*87*	*268*	62	22										
			Cumulative	389	13	*63*	*87*	*181*	*268*	*268*	62	84										
3	Factory stock orders filled	52% of sales orders	Actual	1,752	2,192	625	576	525	425	2,151	154	172										
			Budget	1,917	2,125	580	397	405	628	2,010	156	173										
			Over–*under*	*165*	67	45	179	120	*203*	141	*2*	*1*										
			Cumulative	*165*	67	45	224	344	141	141	*2*	*3*										
4	Special factory orders filled	10% of sales orders	Actual			68	63	68	77	276	41											
			Budget			112	76	78	120	386	30											
			Over–*under*			*44*	*13*	*10*	*43*	*110*	11											
			Cumulative			*44*	*57*	*67*	*110*	*110*	11											
5	Orders placed with iron foundry		Actual																			
			Budget																			
			Over–*under*																			
			Cumulative																			
6	Orders placed with brass foundry		Actual																			
			Budget																			
			Over–*under*																			
			Cumulative																			
7	Orders placed with Department No. 1		Actual																			
			Budget																			
			Over–*under*																			
			Cumulative																			
8	Orders placed with automatic machine dept.		Actual																			
			Budget																			
			Over–*under*																			
			Cumulative																			

(All figures fictitious)

REDUCTION RATIO 12:1

2.0 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

1.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

PM-MGP 13″x18″
METRIC GENERAL PURPOSE TARGET
PHOTOGRAPHIC

200 mm

150 mm

100 mm

A4

A5

1.0

1.1

1.25

1.4

1.6

1.8

1.0 mm

1.5 mm

2.0 mm

2.5 mm

PRECISION℠ RESOLUTION TARGETS

Century

A&P

1303 Geneva Avenue
St. Paul, MN 55119

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

4.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

3.5 mm

FIGURE 44-A

TRENDS IN RELATION TO SALES ORDERS—EXPRESSED IN THOUSANDS OF DOL

	Activity	Budget	Description of computations	1925 Total	1926 Total	1927							
						1st quarter	2nd quarter	3rd quarter	4th quarter	Total	Jan.	Feb.	M
1	Sales orders received	$300 Monthly	Actual	3,687	4,087	1,115	764	779	1,208	3,866	301	333	
			Budget	3,600	3,600	900	900	900	900	3,600	300	300	
			Over–*under*	87	487	215	*136*	*121*	308	266	1	33	
			Cumulative	87	487	215	79	*42*	266	266	1	34	
2	Factory stock orders placed	52% of sales orders	Actual	2,306	2,138	517	373	311	541	1,742	218	195	
			Budget	1,917	2,125	580	397	405	628	2,010	156	173	
			Over–*under*	389	13	*63*	*24*	*94*	*87*	*268*	62	22	
			Cumulative	389	13	*63*	*87*	*181*	*268*	*268*	62	84	
3	Factory stock orders filled	52% of sales orders	Actual	1,752	2,192	625	576	525	425	2,151	154	172	
			Budget	1,917	2,125	580	397	405	628	2,010	156	173	
			Over–*under*	*165*	67	45	179	120	*203*	141	*2*	*1*	
			Cumulative	*165*	67	45	224	344	141	141	*2*	*3*	
4	Special factory orders filled	10% of sales orders	Actual			68	63	68	77	276	41		
			Budget			112	76	78	120	386	30		
			Over–*under*			*44*	*13*	*10*	*43*	*110*	11		
			Cumulative			*44*	*57*	*67*	*110*	*110*	11		
5	Orders placed with iron foundry		Actual										
			Budget										
			Over–*under*										
			Cumulative										
6	Orders placed with brass foundry		Actual										
			Budget										
			Over–*under*										
			Cumulative										
7	Orders placed with Department No. 1		Actual										
			Budget										
			Over–*under*										
			Cumulative										
8	Orders placed with automatic machine dept.		Actual										
			Budget										
			Over–*under*										
			Cumulative										

(All figures fictitious)

FIGURE 44-A

NDS IN RELATION TO SALES ORDERS—EXPRESSED IN THOUSANDS OF DOLLARS

1925 Total	1926 Total	1927					1928										
		1st quarter	2nd quarter	3rd quarter	4th quarter	Total	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
3,687	4,087	1,115	764	779	1,208	3,866	301	333										
3,600	3,600	900	900	900	900	3,600	300	300										
87	487	215	*136*	*121*	308	266	1	33										
87	487	215	79	*42*	266	266	1	34										
2,306	2,138	517	373	311	541	1,742	218	195										
1,917	2,125	580	397	405	628	2,010	156	173										
389	13	*63*	*24*	*94*	*87*	*268*	62	22										
389	13	*63*	*87*	*181*	*268*	*268*	62	84										
1,752	2,192	625	576	525	425	2,151	154	172										
1,917	2,125	580	397	405	628	2,010	156	173										
165	67	45	179	120	*203*	141	*2*	*1*										
165	67	45	224	344	141	141	*2*	*3*										
		68	63	68	77	276	41											
		112	76	78	120	386	30											
		44	*13*	*10*	*43*	*110*	11											
		44	*57*	*67*	*110*	*110*	11											

(All figures fictitious)

FIGURE 44-A—(*Continued*)

TRENDS IN RELATION TO SALES ORDERS—EXPRESSED IN THOUSANDS OF DOLLARS

	Activity	Budget	Description of computations	1925 Total	1926 Total	1927 1st quarter	1927 2nd quarter	1927 3rd quarter	1927 4th quarter	1927 Total	1928 Jan.	1928 Feb.	1928 Mar.	1928 April	1928 May	1928 June	1928 July	1928 Aug.	1928 Sept.	1928 Oct.	1928 Nov.	1928 Dec.
9	Shipments to customers	97% of sales orders	Actual	3,261	4,158	1,137	957	774	1,017	3,885	324	350										
			Budget	3,576	3,964	1,081	741	756	1,172	3,750	293	323										
			Over–*under*	*315*	194	56	216	18	*155*	135	31	27										
			Cumulative	*315*	194	56	272	290	135	135	31	58										
10	Selling expenses	8.0% of sales orders	Actual	278	291	86	79	67	75	307	27	27										
			Budget	295	327	89	61	62	97	309	24	26										
			Over–*under*	*17*	*36*	*3*	18	5	*22*	*2*	3	1										
			Cumulative	17	*36*	*3*	15	20	*2*	*2*	3	4										
11	Purchase orders and purchase contracts issued—all materials including—pig iron, coke and factory supplies	19% of sales orders	Actual	653	915	144	142	136	171	593	48	93										
			Budget	700	776	211	145	148	230	734	57	63										
			Over–*under*	*47*	139	*67*	*3*	*12*	*59*	*141*	*9*	30										
			Cumulative	*47*	139	*67*	*70*	*82*	*141*	*141*	*9*	21										
12	Purchase orders issued—brass sheet, rod, wire, tubing, anodes, etc.	2.2% of sales orders	Actual	79	102	15	14	18	18	65	3	6										
			Budget	81	90	24	17	17	27	85	6	7										
			Over–*under*	*2*	12	*9*	*3*	1	*9*	*20*	*3*	*1*										
			Cumulative	*2*	12	*9*	*12*	*11*	*20*	*20*	*3*	*4*										
13	Purchase orders issued—bronze sheet, rod, wire, tubing, anodes, britannia metal, liberty silver	1.2% of sales orders	Actual	39	52	13	9	6	10	38	3	2										
			Budget	44	49	14	9	9	15	47	3	4										
			Over–*under*	*5*	3	*1*	0	*3*	*5*	*9*	0	*2*										
			Cumulative	*5*	3	*1*	*1*	*4*	*9*	*9*	0	*2*										
14	Purchase orders issued—cold rolled steel	2.1% of sales orders	Actual	92	79	12	15	17	22	66	1	6										
			Budget	77	85	23	16	17	25	81	6	7										
			Over–*under*	15	*6*	*11*	*1*	0	*3*	*15*	*5*	*1*										
			Cumulative	15	*6*	*11*	*12*	*12*	*15*	*15*	*5*	*6*										
15	Purchase orders issued—all steel wire	1.4% of sales orders	Actual	62	55	7	3	9	18	37	3	4										
			Budget	51	57	15	11	11	17	54	4	5										
			Over–*under*	11	*2*	*8*	*8*	*2*	1	*17*	*1*	*1*										
			Cumulative	11	*2*	*8*	*16*	*18*	*17*	*17*	*1*	*2*										
16	Purchase orders issued—pig iron	1.3% of sales orders	Actual	39	77	7	3	7	9	26	15	26										
			Budget	48	53	14	10	10	16	50	4	5										
			Over–*under*	*9*	24	7	7	*3*	7	*24*	11	21										
			Cumulative	*9*	24	7	*14*	*17*	*24*	*24*	11	32										
17	Purchase orders issued—factory supplies	4% of sales orders	Actual																			
			Budget																			
			Over–*under*																			
			Cumulative																			

(All figures fictitious)

REDUCTION RATIO 13:1

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

2.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

2.0 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

1.5 mm

PM-MGP 13″x18″
METRIC GENERAL PURPOSE TARGET
PHOTOGRAPHIC

200 mm

150 mm

100 mm

1.0

1.1

1.25

1.4

1.6

1.8

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

1.0 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

1.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

2.0 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

2.5 mm

A5

A4

A3

PRECISION℠ RESOLUTION TARGETS

Century

A&P

1303 Geneva Avenue
St. Paul, MN 55119

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

4.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

3.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

3.0 mm

FIGURE 45

TREND RATIOS IN RELATION TO FACTORY ORDERS PLACED

	Activity	Budget	Description of computations		1925 Monthly average	1926 Monthly average	1927				1928											
							1st quarter	2nd quarter	3rd quarter	4th quarter	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	Factory assembly orders placed	52% of sales orders	Ratio to Budget	(Mo.)	120	100	89	94	77	86	140	112										
				(Cum.)	120	100	89	91	87	87	140	126										
2	Total payroll	80% of factory orders	Ratio to Budget	(Mo.)	72	107	118	152	159	90	78	90										
				(Cum.)	72	107	118	132	139	124	78	84										
3	Direct labor		Ratio to Budget	(Mo.)																		
				(Cum.)																		
4	Indirect labor in departments		Ratio to Budget	(Mo.)																		
				(Cum.)																		
5	Indirect labor general factory		Ratio to Budget	(Mo.)																		
				(Cum.)																		
6	Number of employees*	1 empl. equal to $750 in fact. ord. per annum	Ratio to Budget	(Mo.)	81	105	113	150	164	93	79	89										
				(Cum.)	81	105	113	128	138	123	79	84										
7			Ratio to Budget																			
8	Total deliveries from stores	35% of factory orders	Ratio to Budget	(Mo.)	80	117	128	130	133	91	80	88										
				(Cum.)	80	117	128	129	130	119	80	84										
9	Deliveries from stores—brass (sheet, rod, etc.)	4.25% of factory orders	Ratio to Budget	(Mo.)	77	123	101	106	133	82	70	78										
				(Cum.)	77	123	101	104	111	102	70	74										
10	Deliveries from stores—bronze (sheet, rod, etc.)	2.5% of factory orders	Ratio to Budget	(Mo.)	87	120	121	100	131	81	69	92										
				(Cum.)	87	120	121	112	117	106	69	79										
11	Deliveries from stores—cold rolled steel	4% of factory orders	Ratio to Budget	(Mo.)	78	105	128	137	124	73	81	81										
				(Cum.)	78	105	128	131	130	112	81	81										
12	Deliveries from stores—steel wire	2.65% of factory orders	Ratio to Budget	(Mo.)	82	114	116	87	119	79	105	86										
				(Cum.)	82	114	116	104	108	99	105	96										
13	Deliveries from stores—pig iron	2% of factory orders	Ratio to Budget	(Mo.)	76	103	138	146	134	77	81	82										
				(Cum.)	76	103	138	141	139	120	81	82										
14	Deliveries from stores—factory supplies 4% sales orders	2% of factory orders	Ratio to Budget	(Mo.)																		
				(Cum.)																		

*The figures for number of employees indicate approximate trends only, as they have not been corrected for number of hours worked.

(All figures fictitious)

REDUCTION RATIO 12:1

2.0 mm ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

1.5 mm ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

PM-MGP 13″x18″
METRIC GENERAL PURPOSE TARGET
PHOTOGRAPHIC

200 mm

150 mm

100 mm

A4

A5

1.0

1.1

1.25

1.4

1.6

1.8

2.0

2.2

2.5

2.8

3.2

3.6

4.0

4.5

5.0

5.6

6.3

7.1

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

1.0 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

1.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

2.0 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

2.5 mm

PRECISION℠ RESOLUTION TARGETS

Century

A&P

1303 Geneva Avenue
St. Paul, MN 55119

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

4.5 mm

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz1234567890

3.5 mm

FIGURE 45

TREND RATIOS IN RELATION TO FACTORY ORDERS PLACED

	Activity	Budget	Description of computations		1925 Monthly average	1926 Monthly average	1927						
							1st quarter	2nd quarter	3rd quarter	4th quarter	Jan.	Feb.	M
1	Factory assembly orders placed	52% of sales orders	Ratio to Budget	(Mo.) (Cum.)	120 120	100 100	89 89	94 91	77 87	86 87	140 140	112 126	
2	Total payroll	80% of factory orders	Ratio to Budget	(Mo.) (Cum.)	72 72	107 107	118 118	152 132	159 139	90 124	78 78	90 84	
3	Direct labor		Ratio to Budget	(Mo.) (Cum.)									
4	Indirect labor in departments		Ratio to Budget	(Mo.) (Cum.)									
5	Indirect labor general factory		Ratio to Budget	(Mo.) (Cum.)									
6	Number of employees*	1 empl. equal to $750 in fact. ord. per annum	Ratio to Budget	(Mo.) (Cum.)	81 81	105 105	113 113	150 128	164 138	93 123	79 79	89 84	
7			Ratio to Budget										
8	Total deliveries from stores	35% of factory orders	Ratio to Budget	(Mo.) (Cum.)	80 80	117 117	128 128	130 129	133 130	91 119	80 80	88 84	
9	Deliveries from stores—brass (sheet, rod, etc.)	4.25% of factory orders	Ratio to Budget	(Mo.) (Cum.)	77 77	123 123	101 101	106 104	133 111	82 102	70 70	78 74	
10	Deliveries from stores—bronze (sheet, rod, etc.)	2.5% of factory orders	Ratio to Budget	(Mo.) (Cum.)	87 87	120 120	121 121	100 112	131 117	81 106	69 69	92 79	
11	Deliveries from stores—cold rolled steel	4% of factory orders	Ratio to Budget	(Mo.) (Cum.)	78 78	105 105	128 128	137 131	124 130	73 112	81 81	81 81	
12	Deliveries from stores—steel wire	2.65% of factory orders	Ratio to Budget	(Mo.) (Cum.)	82 82	114 114	116 116	87 104	119 108	79 99	105 105	86 96	
13	Deliveries from stores—pig iron	2% of factory orders	Ratio to Budget	(Mo.) (Cum.)	76 76	103 103	138 138	146 141	134 139	77 120	81 81	82 82	
14	Deliveries from stores—factory supplies 4% sales orders	2% of factory orders	Ratio to Budget	(Mo.) (Cum.)									

*The figures for number of employees indicate approximate trends only, as they have not been corrected for number of hours worked.

(All figures fictitious)

FIGURE 45

TREND RATIOS IN RELATION TO FACTORY ORDERS PLACED

on ons	1925 Monthly average	1926 Monthly average	1927				1928											
			1st quarter	2nd quarter	3rd quarter	4th quarter	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
(Mo.)	120	100	89	94	77	86	140	112										
(Cum.)	120	100	89	91	87	87	140	126										
(Mo.)	72	107	118	152	159	90	78	90										
(Cum.)	72	107	118	132	139	124	78	84										
(Mo.)																		
(Cum.)																		
(Mo.)																		
(Cum.)																		
(Mo.)																		
(Cum.)																		
(Mo.)	81	105	113	150	164	93	79	89										
(Cum.)	81	105	113	128	138	123	79	84										
(Mo.)	80	117	128	130	133	91	80	88										
(Cum.)	80	117	128	129	130	119	80	84										
(Mo.)	77	123	101	106	133	82	70	78										
(Cum.)	77	123	101	104	111	102	70	74										
(Mo.)	87	120	121	100	131	81	69	92										
(Cum.)	87	120	121	112	117	106	69	79										
(Mo.)	78	105	128	137	124	73	81	81										
(Cum.)	78	105	128	131	130	112	81	81										
(Mo.)	82	114	116	87	119	79	105	86										
(Cum.)	82	114	116	104	108	99	105	96										
(Mo.)	76	103	138	146	134	77	81	82										
(Cum.)	76	103	138	141	139	120	81	82										
(Mo.)																		
(Cum.)																		

number of hours worked.

(All figures fictitious)

FIGURE 45-A

TRENDS IN RELATION TO FACTORY ORDERS PLACED—EXPRESSED IN THOUSANDS OF DOLLARS

	Activities	Budget	Description of computations	1925 total	1926 total	1927 1st quarter	1927 2nd quarter	1927 3rd quarter	1927 4th quarter	1927 Total	1928 Jan.	1928 Feb.	1928 Mar.	1928 April	1928 May	1928 June	1928 July	1928 Aug.	1928 Sept.	1928 Oct.	1928 Nov.	1928 Dec.
1	Factory orders	52% of sales orders	Actual	2,306	2,138	517	374	310	541	1,742	218	195										
			Budget	1,916	2,125	580	397	405	628	2,010	156	173										
			Over–*under*	390	13	*63*	*23*	*95*	*87*	*268*	62	22										
			Cumulative	390	13	*63*	*86*	*181*	*268*	*268*	62	84										
2	Total payroll	80% of factory orders	Actual	1,326	1,828	489	453	396	390	1,728	135	141										
			Budget	1,845	1,710	413	299	249	432	1,393	174	156										
			Over–*under*	*519*	118	76	154	147	*42*	335	*39*	*15*										
			Cumulative	*519*	118	76	230	377	335	335	*39*	*54*										
3	Direct labor		Actual																			
			Budget																			
			Over–*under*																			
			Cumulative																			
4	Indirect labor in departments		Actual																			
			Budget																			
			Over–*under*																			
			Cumulative																			
5	Indirect labor general factory		Actual																			
			Budget																			
			Over–*under*																			
			Cumulative																			
6	Number of employees*	1 employee equal to $750 in factory orders per annum	Actual	1,240	1,501	1,563	1,491	1,361	1,338	1,438	1,379	1,393										
			Budget	1,537	1,426	1,378	992	828	1,442	1,161	1,746	1,560										
			Over–*under*	*297*	75	185	499	533	*104*	277	*367*	*167*										
			Average	*297*	75	185	342	406	277	277	*367*	*267*										
7			Actual																			
			Budget																			
			Over-*under*																			
			Cumulative																			

*The figures for number of employees indicate approximate trends only, as they have not been corrected for number of hours worked.

(All figures fictitious)

FIGURE 45-A—(*Continued*)

TRENDS IN RELATION TO FACTORY ORDERS PLACED—EXPRESSED IN THOUSANDS OF DOLLARS

	Activity	Budget	Description of computations	1925 total	1926 total	1927 1st quarter	1927 2nd quarter	1927 3rd quarter	1927 4th quarter	1927 Total	1928 Jan.	1928 Feb.	1928 Mar.	1928 April	1928 May	1928 June	1928 July	1928 Aug.	1928 Sept.	1928 Oct.	1928 Nov.	1928 Dec.
8	Total deliveries from stores (omitting direct charges)	35% of factory orders	Actual	645	875	231	169	145	159	704	61	60										
			Budget	807	748	181	130	109	174	594	76	68										
			Over–*under*	*162*	127	50	39	36	*15*	110	*15*	*8*										
			Cumulative	*162*	127	50	89	125	110	110	*15*	*23*										
9	Deliveries from stores—brass (rod, wire, tubing, anodes)	4.25% of factory orders	Actual	75.7	111.4	22.2	16.9	17.6	18.8	75.5	6.4	6.5										
			Budget	98.0	90.8	21.9	15.9	13.2	23.0	74.0	9.2	8.3										
			Over–*under*	*22.3*	20.6	.3	1.0	4.4	*4.2*	1.5	*2.8*	*1.8*										
			Cumulative	*22.3*	20.6	.3	1.3	5.7	1.5	1.5	*2.8*	*4.6*										
10	Deliveries from stores—bronze (sheet, rod, wire, tubing, anodes)	2.5% of factory orders	Actual	50.1	63.8	15.6	9.3	10.2	11.0	46.1	3.7	4.4										
			Budget	57.7	53.4	12.9	9.3	7.8	13.5	43.5	5.4	4.8										
			Over–*under*	*7.6*	10.4	2.7	0	2.4	*2.5*	2.6	*1.7*	*.4*										
			Cumulative	*7.6*	10.4	2.7	2.7	5.1	2.6	2.6	*1.7*	*2.1*										
11	Deliveries from stores—cold rolled steel	4% of factory orders	Actual	72.1	89.6	26.3	20.4	15.6	15.7	78.0	7.1	6.3										
			Budget	92.2	85.5	20.6	15.0	12.4	21.6	69.6	8.7	7.8										
			Over–*under*	*20.1*	4.1	5.7	5.4	3.2	*5.9*	8.4	*1.6*	*1.5*										
			Cumulative	*20.1*	4.1	5.7	11.1	14.3	8.4	8.4	*1.6*	*3.1*										
12	Deliveries from stores—steel wire	2.65% of factory orders	Actual	50.4	64.3	15.9	8.6	9.8	11.3	45.6	6.0	4.4										
			Budget	61.1	56.6	13.7	9.9	8.2	14.3	46.1	5.7	5.1										
			Over–*under*	*10.7*	7.7	2.2	*1.3*	1.6	*3.0*	*.5*	.3	.7										
			Cumulative	*10.7*	7.7	2.2	.9	2.5	*.5*	*.5*	.3	*.4*										
13	Deliveries from stores—pig iron	2% of factory orders	Actual	34.9	43.8	14.2	10.9	8.3	8.3	41.7	3.5	3.2										
			Budget	46.1	42.7	10.3	7.5	6.2	10.8	34.8	4.3	3.9										
			Over–*under*	*11.2*	1.1	3.9	3.4	2.1	*2.5*	6.9	*.8*	.7										
			Cumulative	*11.2*	1.1	3.9	7.3	9.4	6.9	6.9	*.8*	*1.5*										
14	Deliveries from stores—factory supplies 4% sales orders	2% of factory orders	Actual																			
			Budget																			
			Over–*under*																			
			Cumulative																			
			Actual																			
			Budget																			
			Over-*under*																			
			Cumulative																			

(All figures fictitious)

FIGURE 46

TREND RATIOS IN RELATION TO SHIPMENTS

	Activity	Budget	Description of computations		1925 monthly average	1926 monthly average	1927				1928											
							1st quarter	2nd quarter	3rd quarter	4th quarter	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	Sales value of goods shipped (gross)	$300,000 monthly $3,600,000 annually	Ratio to Budget	(Mo.) (Cum.)	87 87	115 115	126 126	106 116	86 106	113 108	108 108	116 112										
2	Sales value of goods shipped (net*)	97% of shipments	Ratio to budget	(Mo.) (Cum.)	100 100	101 101	100 100	99 99	100 99	100 100	99 99	101 100										
3	Gross profit		Ratio to budget	(Mo.) (Cum.)																		
4	Net profit		Ratio to budget	(Mo.) (Cum.)																		
5	Administrative expenses	7¾% of shipments	Ratio to budget	(Mo.) (Cum.)	101 101	93 93	92 92	103 97	125 105	97 102	112 112	98 105										
6	Unfilled customers' orders	Equal to 1 mo. shipments Present mo. (*a*)	Ratio to budget	(Mo.)	230	240	101	85	140	136	178	158										
7	Av. total inventories at actual factory cost	Equal to the last 6 mos. ship. at sell. prices (*b*)	Ratio to budget	(Mo.)	103	96	97	111	140	120	114	106										
8	Raw material and fact. supplies at cost	Equal to the last 1.25 mos. Ship. at selling prices (*c*)	Ratio to budget	(Mo.)	105	113	87	102	129	99	97	93										
9	Work in process at actual factory cost	Equal to the last 3 mos. Ship. at selling prices (*d*)	Ratio to budget	(Mo.)	77	70	95	112	137	89	86	82										
10	Finished stock at actual factory cost	Equal to the last 2.5 mos. Ship. at selling prices (*e*)	Ratio to budget	(Mo.)	102	90	80	105	147	97	91	91										

a—Equal to approximately 7 weeks' shipments at actual factory cost.
b—Equal to approximately 10 months' shipments at actual factory cost.
c—Equal to approximately 2 months' shipments at actual factory cost.
d—Equal to approximately 5 months' shipments at actual factory cost.
e—Equal to approximately 4 months' shipments at actual factory cost.
*—Less returns and allowances.

(All figures fictitious)

FIGURE 46-A

TRENDS IN RELATION TO SHIPMENTS—EXPRESSED IN THOUSANDS OF DOLLARS

	Activity	Budget	Description of computations	1925 total	1926 total	1927 1st quarter	1927 2nd quarter	1927 3rd quarter	1927 4th quarter	1927 Total	1928 Jan.	1928 Feb.	1928 Mar.	1928 April	1928 May	1928 June	1928 July	1928 Aug.	1928 Sept.	1928 Oct.	1928 Nov.	1928 Dec.
1	Sales value of goods shipped (gross)	300 monthly 3,600 annually	Actual	3,261	4,158	1,137	957	775	1,018	3,887	324	350										
			Budget	3,600	3,600	900	900	900	900	3,600	300	300										
			Over–*under*	*339*	558	237	57	*125*	118	287	24	50										
			Cumulative	*339*	558	237	294	169	287	287	24	74										
2	Sales value of goods shipped net (less returns and allowances)	97% of shipments	Actual	3,159	4,048	1,104	922	750	991	3,767	311	342										
			Budget	3,163	4,033	1,103	928	751	987	3,769	314	339										
			Over–*under*	*4*	15	*1*	*6*	*1*	4	*2*	*3*	3										
			Cumulative	*4*	15	*1*	*5*	*6*	*2*	*2*	*3*	0										
3	Gross profit		Actual																			
			Budget																			
			Over–*under*																			
			Cumulative																			
4	Net profit		Actual																			
			Budget																			
			Over–*under*																			
			Cumulative																			
5	Administrative expenses	7¾% of shipments	Actual	257	301	81	76	75	76	308	28	26										
			Budget	253	322	88	74	60	79	301	25	27										
			Over–*under*	4	*21*	7	2	15	*3*	7	3	*1*										
			Cumulative	4	*21*	7	*5*	10	7	7	3	2										
6	Unfilled customers' orders	Equivalent to 1 mo. shipment Present mo. (*a*)	Actual	625	831	412	224	400	561	561	577	556										
			Budget	272	346	409	263	286	413	413	324	350										
			Over–*under*	353	485	3	*39*	114	148	148	253	206										
7	Average total inventories at actual factory cost	Equivalent to the last 6 mos. shipments at selling prices (*b*)	Actual	1,678	1,993	2,246	2,320	2,430	2,158	2,158	2,125	2,107										
			Budget	1,630	2,079	2,319	2,095	1,731	1,792	1,792	1,870	1,977										
			Over–*under*	48	*86*	*73*	225	699	366	366	255	130										
8	Raw materials and factory supplies at cost	Equivalent to the last 1.25 mos. ship. at selling prices (*c*)	Actual	357	491	413	406	415	423	423	412	401										
			Budget	339	433	473	399	322	424	424	427	431										
			Over–*under*	18	58	*60*	7	93	*1*	*1*	*15*	*30*										
9	Work in process at actual factory cost	Equivalent to the last 3 mos. shipments at selling prices (*d*)	Actual	630	727	1,074	1,074	1,066	910	910	899	898										
			Budget	815	1,039	1,137	957	774	1,017	1,017	1,042	1,087										
			Over–*under*	*185*	*312*	*63*	117	292	*107*	*107*	*143*	*189*										
10	Finished stock at actual factory cost	Equivalent to the last 2.5 mos. ship. at selling prices (*e*)	Actual	690	775	759	839	949	825	825	813	807										
			Budget	679	866	947	797	646	848	848	889	880										
			Over–*under*	11	*91*	*188*	42	303	*23*	*23*	*76*	*73*										

Figures in total column represent December 31, 1927 conditions.

a—Equivalent to approximately 7 weeks' shipments at actual factory cost.

b—Equivalent to approximately 10 months' shipments at actual factory cost.

c—Equivalent to approximately 2 months' shipments at actual factory cost.

d—Equivalent to approximately 5 months' shipments at actual factory cost.

e—Equivalent to approximately 4 months' shipments at actual factory cost.

(All figures fictitious)

ments will be impossible because deliveries from manufacture have not kept pace with sales requirements, etc.

It is possible to set down approximately the proportions in which these activities should move in relation to sales orders received, and then to develop ratios expressing the relation between the actual activities and these basic proportions. The ratios, when set side by side for successive periods, will indicate the trend and the deviations. Examples of this use of trend ratios are given in Figures 44, 45, and 46. For instance, factory orders for stock, at cost, according to experience should run at about 52% of sales orders received. The ratios in Fig. 44 show that during 1926 factory stock orders placed amounted to only 87% of this norm, and factory stock orders filled 107%, indicating a reduction in work in process and a lag in placing new manufacturing orders. Perhaps, in consequence, the factory orders placed show a decided jump in the first two months of 1927, to a level of 139 and 125 and factory orders filled fall off somewhat to 98 and 99. Shipments to customers (item 9), on the whole, are reducing finished stock. Purchase orders issued (item 16) for pig iron are five times immediate requirements at 488. And so forth.

Operating Reports

Returning to the subject of manufacturing cost variations, the form in which operating reports are to be arranged to present the analysis and interpretation of results is entirely optional. Indeed no general forms can be prescribed, inasmuch as the features which are useful and the data which are to be supplied obviously will vary with each case. The only general prescription that can be made is that reports should be apt and simple, and that there should be neither more reports than can be put to good use nor less than are necessary if proper use is to be made of accounting information.

Nevertheless, one or two additional examples may be worth while, if only as indications of what can be done in the way of assembling data on variations. Figure 47 illustrates a summarized departmental operating report, in which are brought together the figures relating to burden and its analysis for all departments in a plant. Ordinarily, data regarding materials and labor will most suitably be presented

on separate reports. This summary brings out the operating variations for all departments, sub-divided as to spoilage and machine effectiveness, and the unabsorbed burden variations, sub-divided as to the variations in controllable expense (spending variations) and the variations in unused capacity, with a separation of fixed expense variations. Operating ratios are also given in order that the performance in all departments may be brought out in summarized form and the results may be compared.

Figure 48 illustrates a departmental burden report, which may be issued in support of the data contained in the summarized departmental operating report, one being prepared for each department listed on the latter report. The departmental burden report breaks down the spending variations by items of expense, showing the actual expense incurred and the amount by which this is over or under what it should be. What the expense should be depends upon the current operating level and may be determined (as has been described in a previous section) by established percentages. When greater refinement in analysis is desired, different percentages could be used for the several items of expense, which would give the effect of a "variable budget" as to all items of expense. To do this, curves must be set up reflecting the proper trends in the expenses at various operating levels; in fact this is the ultimately desirable way of arriving at the expected percentages, and the itemized variations have more meaning when based on individual instead of departmental percentages.

These examples will suffice for the purpose, which is, as already stated, only to indicate or suggest the manner in which manufacturing cost data may be presented. A great many pages could be filled in the display of other forms, without corresponding benefit, because in the ultimate event the form must be specially devised. Let us therefore leave the subject of operating reports and proceed to consideration of still other kinds of manufacturing cost variations. But before doing so, a word of caution is pertinent. Operating reports of the kind which have been described are valuable and are useful in management, as is apparent on the face of them. It would be a mistake, however, to regard such reports as the means of actual

FIGURE 47

SUMMARIZED DEPARTMENTAL OPERATING REPORT§

Total actual Burden†	Expected Burden†	*Increase* Decrease	Department	Operating variations			Unabsorbed burden variations			Operating ratios				
				Spoilage	Effectiveness	Net	Control expense variation	Unused capacity	Fixed expense variation	Spending level	Operating level	Effectiveness	Labor cost	Production
$24,795	$22,755	$ 2,040	No. 1 Press room No. 2 No. 3 No. 4, etc.	505	*668*	*163*	*660*	*397*	*820*	90.5	74.9	89.6 (*b*)	120	67 (*a*)
$24,795	$22,755	$ 2,040	Total departments	505	*668*	*163*	*660*	*397*	*820*					
			Fixed expenses				Spending variation	Unused capacity						
(The amounts to be shown here are already included above by departments and should therefore not be duplicated in footing.)		*820*	Insurance Taxes Depreciation General plant				*650*	*170*						
$ ——	$ ——	*820*	Total fixed expenses				*650*	*170*						
$24,795	$22,755	$ 2,040	Total plant	505	*668*	*163*	*1,310*	*567*						

NOTES:

§Illustrative figures taken from figure 43.

†Including fixed expenses, analyzed separately below.

(*a*) Standard burden in production to budgeted burden.

(*b*) Reciprocal of burden cost ratio, including spoilage.

FIGURE 48

DEPARTMENTAL BURDEN REPORT °

Actual	*Expected*	*Variation*		*Cumulative variation to date*
$24,795	22,755	*2,040*	Total burden	
7,695	6,875	*820*	Less fixed expense	
$17,100	15,880	*1,220*	Controllable expense	
			Analysis of variation:	
		505	Spoilage	
		668	Machine effectiveness	
		660	Controllable expense	
		397	Unused capacity	
		$1,220	Total.....	
Actual expense		*Variation§*		
			Analysis of controllable expense variation:	
			Supervision	
			Indirect labor	
			Supplies	
			Repairs	
			Etc.	
			Etc.	
$17,100		*660*	Total.....	

Notes:

° Illustrative figures taken from Figure 43.

§ Amount by which actual expense is over or under what it should be, taking expected spending ratio to budget applicable to current operating level—in this case 87.

management—in other words, having such reports, a foreman should not attempt to sit in his office and run his department from the information contained in them. Effective executive management requires the foreman to be out on the floor of his department, in con-

tact with his men, and about among the machines. His control must be exercised by observation and by decision on concrete, tangible problems of daily operation. Some operating data, it is true, will be useful to him in this task, but these must be simple and in elementary form and specific terms: for example, the number of pieces, feet or pounds produced; the number of men working; the number of machines running, etc. These data should be made available daily from the primary sources of information. Transmitting these elementary data to the office for translation into dollars, recapitulation and return to the foreman some time subsequently as an accounting report is useless in executive control.

The usefulness and benefit of the operating reports on departmental results lie in the summing up of performance. They enable the foreman to see in the aggregate and in perspective the results of his daily control, whether the steps taken are being followed and are proving effective, and whether his progress is forward or backward. He is also able from these reports to compare his results with those of others. The distinction, in a few words, is that these operating reports are aids and guides in, but not the instruments of, departmental control.

Reference has been made to still other kinds of variations in manufacturing costs. These are of a nature that might be called compound, involving not only variations in labor, burden and material, but also in yield. They arise in manufacturing processes involving graded products and joint products.

Graded Products

A different situation from that when seconds are produced occurs when the final products are classified into several grades according to some criterion of quality and there is a differential in market values between grades, No. 1 grade, for instance, selling at the highest price, No. 2 grade at somewhat less and No. 3 grade at still less. In the canning industry, raw peas are purchased in bulk but may be sold as canned peas in several grades according to quality. Pineapple is put up in several grades. Cigar wrappers are graded as to quality, but the leaf tobacco was purchased in bulk and is graded in cutting the wrappers for various qualities of cigar. In the fur industry, raw

skins are bought in bulk and subsequently are graded according to quality in course of manufacture.

The distribution of the cost of the lot in such cases is made in proportion to the yield between graded products recovered. That is to say, the entire cost is divided between the products actually derived at the point of grading according to their market values. The entire cost should include handling and processing charges incurred up to the stage at which the grades are determined, as well as the cost of the original purchase.

When standard costs are in use, the market differential between the several grades may be introduced in setting the basic standard costs. Then the actual costs can be distributed on the basis of the standard cost of the products recovered with the same effect as if market values had been used. Inasmuch as the basic standard costs are fixed, this procedure has the advantage of apportioning the initial costs by a set differential, so that should changes in the actual market values of the products occur disproportionately, the consequence will be disclosed in the resulting profits rather than be hidden in costs distributed on the basis of the altered market values.

Basic standard costs can be established as follows:

Figure 49

BASIC STANDARD COSTS

Grade	*Standard yield (quantity)*	*Standard unit cost*	*Calculation of average standard cost*	*Standard yield (amount)*
No. 1	30%	$1.25	.375	36.95%
No. 2	50%	1.00	.500	49.26%
No. 3	20%	.70	.140	13.79%
	100%		$1.015	100.00%

In this example it is assumed that the standard yield as to grades is predetermined in percentages applying to quantity, as shown in the first column. The standard unit cost for each grade is set by deducting the average standard margin from the respective market

values. In this manner the market differential is properly reflected in the unit standard costs of the graded products, so that when these are weighted by the yield percentages they will aggregate the unit standard cost of the lot before grading. As an aid in subsequent calculations, the standard yield is also shown in percentages applicable to dollars at standard costs. These percentages naturally will differ from those applicable to quantity.

If the basic standard costs have thus been established, the distribution of initial costs between grades can readily be made on the basis of standard costs:

FIGURE 50

DISTRIBUTION OF COSTS BETWEEN GRADES ON THE BASIS OF ACTUAL RECOVERY

	Quantity	*Average standard cost*	*Standard cost*	*Actual cost*	*Cost ratio*
Initial cost of material, and processing to the point of separation into grades ..	55,000	$1.015	$55,825	$56,780	101.7
		Actual yield			
Grade		*at standard costs*			
No. 1	11,000	$1.25	$13,750	$15,130	110
No. 2	23,500	1.00	23,500	25,860	110
No. 3	20,500	.70	14,350	15,790	110
	55,000		$51,600	$56,780	
Variation in yield			4,225		
			$55,825		

Average yield { $51,600 ÷ $55,825 or 101.7 ÷ 110 } 92.4

The lot 55,000 represents a standard cost of $55,825 at the average standard unit cost for a standard yield; in other words, embodying the expected proportions between grades to be recovered. The actual cost of the lot is slightly above standard, showing a cost ratio of 101.7. When the grading is completed, the quantities found in each grade are extended at the respective standard unit costs, which leads

to the standard cost of products recovered. The aggregate of such standard costs will equal the initial standard cost only if the yield is standard (or through compensation in variations). Hence any difference between the aggregate standard costs of the products recovered and the initial standard costs will be due to variations in yield. In the present example, these variations have caused the initial cost ratio of 101.7 to rise to 110, because the standard cost of the grades recovered is less than at the outset. The actual costs then are distributed over the standard costs at the resulting cost ratio of 110. Thereby the actual costs put in, so to speak, are divided according to what has come out in the differential of fixed market; the entire actual cost is prorated over what is recovered on this basis.

The variations in yield which have occurred can be analyzed:

FIGURE 51

ANALYSIS OF VARIATIONS IN YIELD

	Standard costs				*Variations*	
Grade	*Standard yield in basic percentage (Fig. 49)*	*Actual yield at basic unit costs (Fig. 50)*	*Yield ratio*	*Standard*	*Actual (a)*
No. 1	$20,625	$13,750	66.7	$6,875	$1,145
No. 2	27,500	23,500	85.5	4,000	1,957
No. 3	7,700	14,350	186.4	6,650	1,195
	$55,825	$51,600	92.4	$4,225	
		Original cost ratio		101.7	$4,297

(a) pro rata on actual yield

It can readily be computed what the amounts of the standard costs by grades would have been had the yield been standard. In this example, the total standard cost of the lot which was sorted into grades is $55,825. If the grades had been present in the standard assortment, the respective standard costs would have been in the percentages established in the basic standard costs (Fig. 49) (percentages applying to amounts). But from the previous calculation (Fig. 50), it is found the standard costs of the existing grades are not in this percentage. The difference between the standard costs computed on the standard yield and on the actual yield is the extent of the

yield variation at standard costs. The assortment affords considerably less of grades No. 1 and 2, with a consequent excess of grade No. 3. The yield ratios indicate this, showing what percentage of the expected values was derived.

The amounts of the variations at standard costs, however, are not the extent to which actual costs are affected, because, in costing graded products, the entire costs are distributed according to what is recovered, not according to what is expected to be recovered. Therefore the increase in costs resulting from the reduced yield on the whole is averaged over what is recovered. The variation in yield of $4,225, at standard costs, must be taken at the original cost ratio of 101.7, because that is the level of the actual cost dollar. The amount of the variation then is $4,297, which applies to the grades recovered pro rata on the actual yield. The amounts so derived, at actual costs, represent the extent to which the unit costs of the recovered grades have gone up as the consequence of the fact that the values recovered have gone down. The correctness of this expression of the amounts of the variations can be shown by a calculation:

FIGURE 52

COMPUTATION SHOWING VARIATIONS IN UNIT COSTS DUE TO VARIATIONS IN YIELD

Grade	*Actual unit costs*	*Actual unit costs had yield been standard* (a)	*Increase*	*Quantity*	*Amount*
No. 1	$1.3755	$1.2713	$.1042	11,000	*$1,146*
No. 2	1.1004	1.017	.0834	23,500	*1,961*
No. 3	.77	.712	.058	20,500	*1,189*
				55,000	*$4,296*

(a) 101.7 × standard unit costs

The yield variations in graded products are averaged over all the grades, because in such cases these variations are principally of content. The variations in processing usually are negligible. (If they are substantial, the situation approaches that which exists in cases of joint products or by-products, next to be considered; then it may be advisable to separate the processing yield variations from the content yield variations.)

The yield variations in graded products are nevertheless important. Generally, it would be desirable to have as high a yield as possible of the higher grades, because they are more valuable and presumably will bring in more profit. Even though the profit margins on the several grades are all alike, a higher quantity of the higher grade will result in a larger amount of profit. A wide variation in yield between grades might lead to a surplus of one grade that would be more difficult to use or sell. The cost variation will also be studied in relation to the yield variation, because a low yield may be obtained on a low cost, whereas a somewhat higher cost might be accompanied by a higher yield that would be more desirable. This comparison will apply especially as to the material price variation. The choice lots in bulk purchases naturally command somewhat better prices.

There may also be an effect upon profits should there be any disproportionate changes in market values between grades. This would be disclosed by the margin between actual cost and selling price, because the costing is based upon the fixed differential of the standard costs. If the products are not sold at this point but enter into further processing, the same effect ensues, because costs are not affected by the changes in the market values of the intermediate products; but the market values of the ultimate products usually vary correspondingly.

CHAPTER VIII

MANUFACTURING COST VARIATIONS; JOINT PRODUCTS

Some of the most interesting and complicated problems in industrial accounting arise in manufacturing operations wherein various products are derived jointly from the initial processes. Such products, in contradistinction to graded products, are of different character or for different purposes and may be salable at certain stages or subject at choice to further processing into still other products. Instances of such operations are found in the packing and chemical industries, oil refining, the manufacture of by-product coke, of corn starch and by-products, etc.

The word "by-product" is troublesome in accounting terminology. Frequently by-products are of considerable value. They may even be worth more than the so-called "main" products from which they derive. In by-product coke operations, the coke produced sells for less than the cost of the coal from which it is made. The implication in the word "by-product" that a product is merely nominal, because it is incidental to the obtainment of some other, may lead to superficial accounting treatment. Such products are better regarded as joint products, differing, it is true, in importance and value as well as nature, but nevertheless meriting equal consideration as products.

Apportioning Initial Costs

The first problem which arises is how the cost of the original material, together with the costs of processing up to the first point of separation in the products, are to be allotted to the respective products. Owing to the difference in character of these products, there is

usually no common standard among them to be used as the natural basis for apportioning the initial costs.

Several methods are available:

(1) Weight
(2) Common measure, e.g., British thermal units
(3) Market value
(4) Recovery (market value less recovery costs).

Occasionally no attempt is made to apply initial costs against by-products. They are then (1) treated as miscellaneous income upon sale or (2) charged with the costs of supplementary processes only. For an explanation of these methods see National Association of Cost Accountants publication, Vol. 1, No. 7, August 1920, "Accounting for By-Products". Unless the products involved are really of minor importance, however, these methods are more a means of evading the problem than of solving it.

The most natural basis for distributing initial costs would be weight, if the products were approximately equal in ultimate unit values. This is seldom the case, because weights as a rule do not parallel values. Hence, when weights are to be used, some means of equation must be adopted whereby the actual weights of the products can be converted into proportions of the total weight of the original material consumed. (A weight basis for charging coal and carbonizing costs in by-product coke operations is suggested by C. C. Sheppard, National Association of Cost Accountants publication, Vol. IV, No. 6, December 1, 1922, "Cost Practices and Problems in the Production of Coke".)

When some common measure such as British thermal units exists, it may be used for allotting initial costs by ascertaining the content in each product, on the theory that the sum of these units was contained in the original material and therefore the cost of this material applies to the products as the content is distributed among the products. This method, however, again may be out of line with the values recovered. Moreover, such a common measure is seldom at hand.

The market value of the products recovered is evidently most representative of what has been produced as the result of the process;

consequently it may be held that the cost of the original material, together with the cost of processing it, should be apportioned pro rata between the products as their values appear. But there are some disadvantages in this idea. When market values are used, the costs are affected if these values fluctuate. Variations in costs will be introduced, because in many cases the market values of the products will not fluctuate alike. Sometimes there is no market for a derivative in the stage in which it is first obtained. Or a derivative may be converted into two or more products, according to the demand, these products having different market values and making it difficult to place a value upon the derivative. (For an able presentation of the principle of relative values in joint costs see "A Problem in Joint Costs", by William Morse Cole, *Harvard Business Review,* Vol. 1, No. 4, July, 1923.)

The true basis upon which to apportion initial costs between joint products is the potential worth of the products to be recovered at the point of separation. The establishment of this basis involves consideration of several factors:

(1) The market value of the products to be recovered
(2) The subsequent recovery costs
(3) The variations in recovery, i.e., the yield variations
(4) The content of the products in the original material, i.e., the products there to be recovered.

The market value of the products to be recovered, being the object of the undertaking, must be an important factor in establishing the basis for distribution of the costs incurred to obtain them. Their differentials should be brought into account, but in order to avoid the fluctuations caused by changing market prices, they should be fixed. Fixed prices can be interpolated for intermediate products, for which no market exists. The fixed market prices then will serve the purpose of establishing relative values, free from market fluctuations.

Subsequent recovery costs must also be taken into consideration, because most of the products will require treatment before they are marketable. Therefore the recovery costs, which are the costs of

processing from the point of separation to the point of salability, must be deducted from the market value of the products to ascertain their potential worth when first obtained. In order again to avoid the influence of fluctuations in recovery costs, these deductions should be made at fixed standard costs. The worth of the products recovered, then, is their recovery value, namely standard market less standard recovery cost.

But there is still another factor to be considered—the yield of the various products recovered. This yield will vary. If the yield variations are not anticipated, as is the case when initial costs are apportioned according to the market value of products actually recovered, the effect on costs is to merge the yield variations. That is to say, the variation in yield on the whole is distributed among the products, relatively. This may be inequitable—for example, if some of the products show a high yield but on the whole there is a reduced yield, all the products would share in the loss, which will be emphasized as to the products showing a high yield.

Variations in yield may be due either to changes in the content of the original material or to gains or losses arising in processing. The latter are clearly variations in effectiveness. They are then logically to be regarded in the same category as spoilage or other operating variations and, as such, should be taken up in the costs of the products on which they arise. This can be accomplished by basing the distribution of initial costs upon the products which should be recovered, namely, upon the standard yield, rather than upon the products actually recovered. A decline in yield, then, will result in an increase in the initial cost per unit of product, because the distribution has not been altered to correspond. A gain in yield will cause a reduction in the initial cost per unit of the product on which it occurs, because no initial costs are apportioned for the extra yield obtained.

Were the yield variations confined to those occurring in processing, this procedure would be adequate, but in most cases there are also variations in original content, i.e., in the ingredients composing the original materials, which affect the final yield. It would not be right to apportion initial costs on the basis of a standard yield regardless entirely of the composition of the material, because to do so

would be to divide the costs according to an assumption which may not fit the fact. The potential worth of the products to be recovered at the point of separation necessarily depends, in the first instance, upon the proportions in which they are present in the raw material. If these proportions can be ascertained and introduced into the computation, the resulting initial costs of the products will then be influenced only by the yield variations which occur in processing.

Fortunately, it is usually feasible to ascertain, by testing, sampling or chemical analysis, the composition of the original material and to compute within reasonable limits of error the proportions in which the respective products should be available. When this can not be done, there is plainly no alternative but to distribute initial costs on the basis of actual recovery. But when this can be done, basic standard costs can be set up, embodying (1) the formula in which the products should be recovered and (2) their market differential modified by (3) their subsequent recovery costs. Basic standard rates should first be established:

FIGURE 53

BASIC STANDARD RATES

Material "X"	$3.75	per gross ton
Initial processing	1.00	" " "
	$4.75	" " "

Product	*Unit*	*Market*	*Recovery cost*	*Recovery*
"A"	Net ton	$3.21	—	$3.2100
"B"	M cu. ft.	.50	$.1429	.3571
"C"	gal.	.05	.0050	.0450
"D"	lbs.	.025	.0035	.0215
"E"	gal.	.20	.0334	.1666

These are the fixed prices to be applied to the various products. The basic standard costs, for a particular process and an ascertained formula as to content of a given material or compound to be processed, then can be set up:

FIGURE 54

BASIC STANDARD COST—PROCESS NO. 101

Material "X" 1 gross ton.....$3.75
Initial processing cost..... 1.00

$4.75

Products at standard yield		*Recovery*		*Yield %*	*Standard initial cost*	*Standard initial cost per unit*
"A" .67 N. T.	@	$3.21	$2.15	34.40	$1.634	$2.44 p N. T.
"B" 7M cu ft.	@	.3571	2.50	40.00	1.90	.2714 p M cu. ft.
"C" 12 gal.	@	.045	.54	8.64	.41	.0342 p gal.
"D" 26 lbs.	@	.0215	.56	8.96	.426	32.76 p N. T.
"E" 3 gal.	@	.1666	.50	8.00	.38	.1267 p gal.
			$6.25	100.00	$4.75	

A given quantity of material "X" is determined by chemical analysis to contain products "A", "B", "C", "D" and "E" in the proportions shown. These products, extended at the fixed market prices less recovery costs, will yield certain amounts. The percentage of this yield, when applied to the cost of the material "X", plus the initial processing cost, gives the initial cost per unit of the products to be recovered. These standard costs are to be used subsequently as the basis for apportioning initial costs and ascertaining yield variations:

FIGURE 55

DISTRIBUTION OF INITIAL COSTS ON THE BASIS OF STANDARD YIELD

	Actual	*Standard*	*Cost ratio*
Initial costs, material and processing....	$56,780	$51,600	110

Actual recovery	*Standard yield (Fig. 54)*	*Actual cost on standard yield*	*Actual yield at standard costs*	*Cost ratio*	*Yield ratio*
"A" 6,930 N. T.	34.40%	$19,532	$16,902	115.5	95.3
"B" 70,150 M cu. ft.	40.00	22,712	19,039	119.2	92.3

Actual recovery	*Standard yield (Fig. 54)*	*Actual cost on standard yield*	*Actual yield at standard costs*	*Cost ratio*	*Yield ratio*
"C" 135,523 gal.	8.64%	$ 4,906	$ 4,635	106	104
"D" 282,407 lbs.	8.96	5,088	4,626	110	100
"E" 33,556 gal.	8.00	4,542	4,252	107	103
	100.00%	$56,780	$49,454	114.8	96
Yield variation, at standard costs....		2,146			
		$51,600			

When the products actually recovered are extended at standard initial costs, the aggregate will differ from the total standard cost of raw material and initial processing. The difference will be due to the variations in yield which have occurred in all the products, because, if there were no variations from the yields set down in the basic standard costs, the aggregate standard cost of the products would equal the initial standard cost. Moreover, the variations must have arisen in processing, because the basic standard costs are founded upon an analysis of raw material content, thus eliminating variations which might arise from the composition of the material.

Against the standard cost for each product recovered, the actual costs are distributed in the percentage predetermined for the standard yield (Fig. 55). The resulting ratio of actual to standard cost for each product then represents the extent of (1) the variation in initial costs and (2) the variation in yield. The former is contained in these ratios pro rata for all products, but the latter is specific for each product. Thus the yield variation is introduced into the cost of the product on which it arose.

The cost ratio on product "A" is 115.5. It has increased from the opening ratio, 110, because the yield of product "A" was less than expected. The yield ratio will be found by dividing the cost ratio by the opening cost ratio. The yield of product "A" was 95.3% (110÷115.5).

The yield was also down on product "B". It was 92.3% and consequently brought about the cost ratio of 119.2. As to product "C", the cost ratio is 106, which is less than the opening cost ratio, 110, indicating that the yield was better than standard, namely, 104. The cost ratio on product "D" is 110, remaining unchanged from the opening ratio, showing that the yield of this product was equal to standard.

The average yield as to all products shows a ratio of 96 to standard. The example illustrates how the yield may vary between products. If the initial costs are distributed to products on the basis of actual yield, that is to say, on the basis of products actually recovered at their recovery values, the results will be quite different. Using the same figures as before, the computation would be:

FIGURE 56

DISTRIBUTION OF INITIAL COSTS ON BASIS OF ACTUAL YIELD

	Actual	*Standard*	*Cost ratio*
Initial costs, material and processing....	$56,780	$51,600	110

Actual recovery	*Actual cost on actual yield*	*Actual yield at standard costs*	*Cost ratio*	*Yield ratio*
"A" 6,930 N. T.	$19,411	$16,902	114.8	
"B" 70,150 M cu. ft.	21,857	19,039	114.8	
"C" 135,523 gal.	5,321	4,635	114.8	
"D" 282,407 lbs.	5,310	4,626	114.8	
"E" 33,556 gal.	4,881	4,252	114.8	
	$56,780	$49,454	114.8	96

The effect of apportioning the initial costs in this manner is to introduce the average yield variation pro rata into the costs of the products recovered. Then all the products stand at a cost ratio of 114.8, which is caused by the average yield. This is not in accordance with the facts. The yields of the respective products varied differently; two showed a reduced recovery, two an increase in yield and one a yield exactly as expected. As previously stated, the variations can only be due to effectiveness in processing, inasmuch as the expected yield is determined by chemical analysis of the raw material.

Therefore, the costs of the products should be affected accordingly, and affected particularly—that is, the cost of each product should include the yield variation for that product. Otherwise the cost of each product would be disturbed by the yield variations of all other products as well. The average costing of the yield variation would be correct only if the different yields were conjunctive, so that a change in the production of one would cause changes in the production of the rest in the proportions in which they occur.

The processing yield, of course, may be varied intentionally. It may be possible, by different treatment, to obtain a greater yield on some products at the sacrifice of that on some others. This, however, is practically a different process, and therefore requires the use of a different formula in establishing the basic standard costs, to conform with the intention. It is as if the ingredients were present in the raw material in another proportion, because it is the purpose to abstract them in that proportion. Such variations, then, are not to be confused with the processing yield variations already described.

To illustrate the difference in results between distributing initial costs on the basis of standard yield and on the basis of actual yield, it will be interesting to examine the consequent margins of profit. In the following tables, for the sake of simplicity, the recovery costs and market values are calculated at standard, although it must be remembered that in an actual case these also would vary.

In Fig. 57, the profit margin on sales is quite different between products, owing to the effect of the yield variations. In Fig. 58, the differential has been subdued by the averaging of the yield variations in apportioning initial costs. There are still differences in margins, but these are due to the fundamental spread between cost and market. The differences are not as marked as they appear in Fig. 57. Under that method of calculation, it is possible for a product to show a loss if the yield be down, recovery costs high and market low.

Under the method of calculation whereby the initial costs are distributed on the basis of actual yield and actual recovery values, it is impossible to show a loss on any product, so long as market is above recovery cost for all products and there is a margin between

FIGURE 57

MARGIN ON SALES, BASING INITIAL COSTS ON STANDARD YIELD, WITH MARKET AND RECOVERY COSTS UNCHANGED

	Production	Initial costs (Fig. 55)	Recovery costs at standard Unit	Recovery costs at standard Amount	Total costs	Market at standard Unit	Market at standard Amount	Margin Amount	Margin %
"A"	6,930 N. T.	$19,532			$19,532	$3.21	$22,245	$2,713	12.3
"B"	70,150 M cu. ft.	22,712	.1429	$10,024	32,736	.50	35,075	2,339	6.8
"C"	135,523 gal.	4,906	.0050	678	5,584	.05	6,776	1,192	17.6
"D"	282,407 lbs.	5,088	.0035	988	6,076	.025	7,060	984	13.9
"E"	33,556 gal.	4,542	.0334	1,121	5,663	.20	6,711	1,048	15.6
		$56,780		$12,811	$69,591		$77,867	$8,276	10.6

FIGURE 58

MARGIN ON SALES, BASING INITIAL COSTS ON ACTUAL YIELD, WITH MARKET AND RECOVERY COSTS UNCHANGED

	Production	Initial costs (Fig. 56)	Recovery costs (Fig. 57)	Total costs	Market (Fig. 57)	Margin Amount	Margin %
"A"	6,930 N. T.	$19,411		$19,411	$22,245	$2,834	12.7
"B"	70,150 M cu. ft.	21,857	$10,024	31,881	35,075	3,194	9.1
"C"	135,523 gal.	5,321	678	5,999	6,776	777	11.5
"D"	282,407 lbs.	5,310	988	6,298	7,060	762	10.8
"E"	33,556 gal.	4,881	1,121	6,002	6,711	709	10.6
		$56,780	$12,811	$69,591	$77,867	$8,276	10.6

FIGURE 59

MARGIN ON SALES, BASING INITIAL COSTS ON STANDARD YIELD AND ASSUMING THE CONDITIONS AS TO PRODUCT "B" OF LOW YIELD, HIGH RECOVERY COSTS AND LOW MARKET

Product	Initial costs (Fig. 55)	Recovery costs unit	Recovery costs Amount	Total costs	Market unit	Market Amount	Margin (Loss) Amount	Margin (Loss) %
"A" 6,930 N. T.	$19,532	.16	$11,224	$30,756	$3.21	$22,245	$2,713	12.3
"B" 70,150 M cu. ft.	22,712	.48	33,672	56,384	.48	33,672	264	.785
"C" 135,523 gal.	4,906	.05	6,776	11,682	.05	6,776	1,192	17.6
"D" 282,407 lbs.	5,088	.025	7,060	12,148	.025	7,060	984	13.9
"E" 33,556 gal.	4,542	.20	6,711	11,253	.20	6,711	1,048	15.6
	$56,780		$76,464	$122,223		$76,464	$5,673	7.42

FIGURE 60

MARGIN ON SALES BASING INITIAL COSTS UPON YIELD AT ACTUAL RECOVERY VALUES AND ASSUMING THE SAME CONDITIONS OTHERWISE AS IN FIG. 59

Product	Market (Fig. 59)	Recovery Costs (Fig. 59)	Recovery Amount	Recovery %	Initial costs	Total costs	Margin Amount	Margin %
"A"	$22,245		$22,245	35.62	$20,225	$20,225	$2,020	9.1
"B"	33,672	$11,224	22,448	35.93	20,401	31,625	2,047	6.1
"C"	6,776	678	6,098	9.77	5,547	6,225	551	8.1
"D"	7,060	988	6,072	9.72	5,519	6,507	553	7.8
"E"	6,711	1,121	5,590	8.96	5,088	6,209	502	7.5
	$76,464	$14,011	$62,453	100.00	$56,780	$70,791	$5,673	7.42

cost and market for the initial process as a whole. In the following tables are calculations under both methods, assuming that there is a margin on the initial process as a whole, but that the yield on one product is low while, at the same time, recovery costs have increased and selling prices have decreased.

In Fig. 59, wherein initial costs are applied specifically according to yield, product "B" shows a loss. But in Fig. 60, the initial costs are spread over all the products recovered on the basis of their net market values, the loss is absorbed and the profit margins on all products are leveled.

The extent of the processing yield variations can be brought out by analysis:

FIGURE 61

ANALYSIS OF YIELD VARIATIONS

Product	Standard yield at standard cost % (Fig. 54)	Standard yield at standard cost Amount	Actual yield at standard cost (Fig. 55)	Variation (Loss) Standard		Variation (Loss) Actual
"A"	34.40%	$17,751	$16,902	$ 849	110	$ 934
"B"	40.00	20,640	19,039	1,601		1,761
"C"	8.64	4,458	4,635	177		195
"D"	8.96	4,623	4,626	3		3
"E"	8.00	4,128	4,252	124		136
	100.00%	$51,600	$49,454	$2,146		
				× 1.10		$ 2,361

The figures in the column headed "Standard yield at standard cost" represent the distribution of the standard initial costs (raw material and processing) between the products on the basis of the standard formula. Had the yields not varied, the standard costs of the products would have been in these amounts. But the yields did vary; consequently the standard costs of the respective products appear as in the column headed "Actual yield at standard cost". These figures are obtained by pricing production at the basic standard costs per unit.

The difference between the first and second figures represents the yield variation on each product in terms of standard costs. But, inasmuch as the initial costs stood at a cost ratio of 110, which represents the level of the actual cost dollar, the amounts of the variations must be taken at the ratio 110. The resulting amounts express the extent of increases or decreases in unit costs of the products recovered owing to the respective yield variations.

As in the similar calculation in the case of graded products, the correctness of this expression of the amounts of the variations can be demonstrated by calculating the changes in actual unit costs caused by the yield variations:

FIGURE 62

COMPUTATION SHOWING EFFECT OF YIELD VARIATIONS ON UNIT COSTS

Product	*Actual unit cost (based on (Fig. 55)*	*Actual unit cost had yield been standard (a)*	*Variation*	*Quantity*	*Amount*
"A" (N. T.)	$2.818	2.683	.135	6,930	$ 935
"B" (M cu. ft.)	.3237	.2985	.0252	70,150	1,768
"C" (gal.)	.0362	.03762	.00142	135,523	195
"D" (N. T.)	36.03	36.03		282,407	
"E" (gal.)	.1353	.1393	.004	33,556	134
					$2,374

(a) 110 × standard unit costs (Fig. 54)

To recapitulate, the true basis for apportioning initial costs to joint products is the potential worth of the products to be recovered at the point of separation. This should be computed under a formula involving content of the respective products in the raw material, taken at standard market prices, less standard recovery costs. The resulting recovery values determine the proportion in which initial costs are to be applied to the products. When it is impossible to obtain the formula of content, the distribution must be in the proportion of recovery values of the products actually obtained. In both

cases it is preferable to use fixed market prices and fixed recovery costs, in order to bring out the variations in the profit or loss on each product, free from the accentuation which would take place if the initial costs also were influenced by such variations.

Stand costs afford two advantages in carrying these principles into effect; namely: (1) they serve as the basis for bringing out processing yield variations, as well as apportioning the accompanying cost changes properly between the products, and (2) they serve as a constant basis for introducing the market differential. Both advantages are important. In case of joint products, control over the processing yield variations is one of the principal problems in manufacturing operations. Therefore data which may facilitate such control is valuable. Introduction of a fixed market differential is useful in clarifying the figures, because it avoids carrying a foreign variation into costs. It is obviously inconsistent to hold that the manufacturing cost of one of two or more joint products is different because the market price for it is different. It is even more so when the difference is based on changing market prices for all the joint products. The cost of a product is not less because of close competition or a falling market for it. Conversely, the cost of a product is not greater because of an open market or because a better selling price can be obtained. What changes is the margin obtained upon sale of the product. The variations in cost are confined to changes in the cost of the raw material and in the effectiveness in processing.

There is a disadvantage attendant upon the procedure described, and it should be mentioned. The initial standard costs are subject to changes continually for content variations and for changes in processes. Every time a different content formula is used, another unit standard cost for the product ensues. This is true also when a different process is adopted, yielding some or all of the same products in other proportions. Thus the unit initial standard cost for a product will not be constant. It is desirable to maintain the constancy of the standards. A remedy for the difficulty is to use the varying standard costs for the purposes described and then to substitute a fixed standard cost when the products are delivered from process. The initial costs can be carried through the work in proc-

ess and, when the final products are sold or stored, the fixed basic standard costs can be substituted, adjusting the accounts for the difference.

It will of course be understood that the examples used are hypothetical and the features illustrated are arbitrarily selected. They will serve to bring out the principles described. The results obtained under different methods of apportioning initial costs should be considered when the choice of method is made. No general rule can be laid down, because the circumstances in cases involving joint products are peculiar in each instance. Each process will have its special inter-relationships and complexities, calling for adaptation of the general principles.

CHAPTER IX

ANALYSIS OF VARIATIONS IN PROFITS ON THE BASIS OF STANDARD COSTS

Interpretation of Variations—Selling Operations

It is not generally understood that standard costs are useful in industrial accounting analysis beyond the realm of factory operation and manufacturing costs. Cost data are ordinarily confined to these departments and the term "standard costs" implies no further applications until it transpires that the standard costs, which are useful as the fixed basis of measurement in the factory, may logically be so used further in appraising results upon subsequent sale of the products. The standard cost of goods sold, being constant, is available as a base for disclosing the variations in selling prices, profit margins and composition of sales which have affected the ultimate profits.

Ordinarily, without standard costs, it is a difficult proceeding to explain what influences caused the profits to vary from the expected profits, and to what extent each influence has contributed to the net result. In order to supply such information, it is necessary to have a means of quantitative measurement. When the variety of products is small, so that it is feasible to carry records in quantities as well as in dollars (that is, in pieces, pounds, tons or number of units of each size and kind of product sold), the information can be obtained readily. It is then possible to ascertain how much of the change in profits is due to the number of articles sold, their selling prices, their costs and the relative quantities which make up the total sales. In the majorty of cases, however, it is not feasible to keep such detailed records of quantities, because of the number and variety of products. Then the use of standard costs as the basis for

calculating the variations in profits is the only means available within the compass of reasonable effort.

As in the case of manufacturing costs, the variations between the profits actually realized and those which were expected can be classified under definite headings, which might be called the underlying factors of variations in profits (see diagram, Fig. 7, page 20). These factors again are inter-related and, in some instances, interdependent. They are always present, and any gain or decline in profits can be attributed to the elementary trends which, singly or in combination, have brought it about.

The underlying factors of variation are as follows:

Variation in net profits:
- Variation in distribution and general expenses
- Variation in gross profits:
  - Variation in unabsorbed manufacturing expenses
  - Variation in margin on sales:
    - Variation in cost of goods sold
    - Variation in amount of net sales:
      - Variation in volume
      - Variation in effective price level:
        - Variation in selling prices
        - Variation in composition of sales:
          - Variation in proportion (i.e. jobber, dealer proportion)
          - Variation in assortment of products sold.

Net profits, obviously, are the remainder of gross profits after distribution and general expenses have been met. (The analysis of net profit variations is omitted, inasmuch as this would involve the whole question of how to apply shipping, selling, distributing and administrative expenses, which would require another volume to treat adequately. Standards totally different from the basic standard costs of products, which are presently concerned, are required for these expenses.) Gross profits consist of the margin on sales, less unabsorbed manufacturing expenses which were not included in cost of goods sold (or, plus any over-absorbed manufacturing expenses). The margin on sales is the difference between the net sales and the cost of the goods sold; but the amount of net sales is affected by several

variables. In the first place, it is affected by the volume of sales and the average price level at which the goods were sold. The average price level, in turn, is made up of the selling price level and the composition of sales, which may have made the aggregate sales dollars greater or less. The composition of sales, finally, is determined by the proportion between the kinds of sales, with reference to trade price classes (i.e. jobbers, dealers) and the assortment of products sold. Any change in the proportion of sales between jobbers and dealers, for example, will affect the level of the aggregate sales dollars and, therefore, the profits, because of the difference in trade discounts. Any change in the assortment of products sold will likewise affect profits, because all products will not carry the same margins. Hence, the sale of a greater relative volume of products having narrower margins would lead to a decline in profits, unless the increase in volume were so great as to offset the effect of the narrower margin.

It is useful to ascertain each of these factors for each kind of products. The information may be valuable in determining sales or manufacturing policies and in guiding selling activities.

For the sake of clearness, hypothetical examples are again used to explain how the respective variations are isolated, taking one variation at a time and progressing in steps. If at first the calculations appear complex, it must be remembered they are no more so than the problem which is being analyzed. Managing a business in order to make a profit is by no means a simple problem. As the several calculations are followed and their principles are understood, it will be found that their complexity will largely fall away and that each calculation, by itself, is essentially a simple one. In practice the mathematics involved becomes a matter of routine calculation, often made by the aid of mechanical devices.

The Sales Budget

At the beginning of the calculation of variations in profits, it is necessary to have a budget of expected sales and profits. Leaving aside entirely the modus operandi, such a budget is a summary of the products which it is expected to sell at expected selling prices, costs and profits. It may be indicated by an example:

FIGURE 63

BUDGET OF SALES AND PROFIT MARGINS

	Basic standard		*Expected results*	
Products	%	*Amount*	*Amount*	*Ratio to std.*
A:				
Sales	100	$50,000	52,250	95 (a)
Cost	80	40,000	46,200	105 (b)
Margin	20	$10,000	6,050	
Volume				110 (c)
B:				
Sales	100	70,000	84,700	98
Cost	85	59,500	74,200	101
Margin	15	$10,500	10,500	
Volume				123.5
C:				
Sales	100	130,000	109,200	105
Cost	90	117,000	89,856	96
Margin	10	$13,000	19,344	
Volume				80
D:				
Sales	100	50,000	43,650	97
Cost	75	37,500	31,725	94
Margin	25	$12,500	11,925	
Volume				90
Total:				
Sales	100	300,000	289,800	99.8
Cost	84.7	254,000	241,981	99.3
Margin	15.3	$46,000	47,819	
Volume				96.4

Notes:

(a) Expected price level.
(b) Expected cost level.
(c) Expected volume level.

THE BASIC SALES BUDGET

When fixed standard costs are used, that is to say, standard costs which are not changed to follow current cost and market levels, the budget of sales and profit margins may be set up to serve as the basis for subsequent calculations over a long period of time. The expected results for any given period—year, season or even month—can be set forth by applying ratios to the basic standard costs in the original budget, corresponding to experience or to judgment as to the trend for the period to come. In Fig. 63, the expected results are obtained by applying ratios in this manner. For product A, an expected price level of 95 is shown. The products are expected to cost 105% of standard. It is expected to sell 110% in volume. Consequently, the amount of sales would be $110 \times 95 = 104.5$ of the basic budget of sales: $50,000; which is $52,250. The amount of costs would be, at standard, 110% of the basic budget of $40,000, or $44,000, which at a cost ratio of 105 would yield actual costs of $46,200. In these proportions the profit margin would be $6,050.

In a similar manner, the level of expected sales, expected costs and expected profit margins can be set down for each product. The calculations are so simple and easily made that a revision of the budget at any time is no problem. It is also possible to estimate in advance the probable result of any desired combination of these factors—of any foreseen variation in prices, costs, volume, etc.

Assuming such a basic budget to have been established and expected results to have been determined in this way, let us further assume that the actual results in a month for product A are as follows:

FIGURE 64

SALES AND PROFIT MARGIN—PRODUCT A

	Actual results	*Expected results*
Net sales	$54,480	$52,250
Cost of goods sold	49,680	46,200
Margin	$ 4,800	$ 6,050

	Actual results		*Expected results*
Decline in profit		*$1,250*	
Standard costs	$46,000		$44,000
Actual margin	10.4348%		(on Standard Cost)

The actual results show a decline in profit of $1,250, notwithstanding an increase of $2,230 in the amount of net sales. The cost of goods sold is greater than expected by $3,480. The combined effect is a lower profit, amounting to the difference between them. This does not tell the whole story, however, as it is not clear whether the increase in sales results from selling more goods or selling them at higher prices or selling a higher priced assortment. It is not plain how much of the greater cost is due to an increase in costs and how much may be due to a higher volume. In order to ascertain the extent and direction of the variations which occurred, the standard cost of goods sold is set down. When this is done it becomes evident there was an increase in volume, because the standard cost of goods sold is $2,000 greater than expected.

Volume Variation

Assuming for the moment that the character of products sold is as expected, the only factor that would lead to an increase in standard cost of goods sold is a variation in the quantities which were sold—that is to say, an increase in volume:

Figure 65

VOLUME

Budgeted standard cost of goods to be sold; Product A (Fig. 63)	$40,000
Standard cost of goods actually sold (Fig. 64)	46,000
Volume ratio (to basic budget)	115

The level of the current volume of sales can be expressed by the ratio of the standard cost of goods sold to the standard cost of goods to be sold originally set down in the basic budget. In this instance, the volume ratio is 115.

It will be recalled that the expected volume ratio is 110 (Fig. 63). Therefore, there has been a gain of 5 points in volume. This gain must have brought about a corresponding gain in profits, inasmuch as the goods on the whole were sold at a profit. The amount of the gain is hidden in the net decline from the expected profit but is easily ascertained:

Figure 66

VOLUME VARIATION

Expected volume, product A; ratio to basic budget (Fig. 63)	110
Expected standard cost of goods sold	$44,000
Standard cost of goods actually sold (Fig. 64)	46,000
Increase	$ 2,000
Actual margin (Fig. 64)	10.4348%
Volume variation—gain	$ 209

Expressed in percentage to the standard cost of goods sold, the actual margin is 10.4348%. The pro rata share of it on the increased volume of sales is $209, which may be set down as the gain in profits running with the variation in volume. It is true that the particular articles sold beyond expectations may have brought in more or less than this amount, but it is not practicable to single them out and identify the amount of profit or loss specifically incurred on them. Moreover, a variation of this nature is rather a matter of the character of goods sold, the disclosure of which is the object of another calculation—as to the assortment variation. This will be undertaken later; for the present calculation on the basis of a uniform assortment, the gain in profits may fairly be computed at the average margin for the product. The expression of the variation is this: existing other conditions remaining as they are, each increase in volume of $2,000 brings a gain in profits of $209, or a corresponding decline in the event of a decrease in volume.

The calculation of the volume variation is sometimes made at a standard or expected profit percentage. Had that been done in this example, the amount of the variation would have been $275 gain, the expected profit being 13.75% on standard cost. This amount rep-

resents the expected profit which would have been realized upon the increase in volume had other factors not changed and so reduced it. It is to this extent hypothetical, because the other factors did change. It is, therefore, not the amount of profit actually realized on the increased volume. The profit would not have been less to the extent of $275 had the volume not increased. The truth is that under the prevailing conditions the amount of profit would have been less by $209 had more goods not been sold, owing to the effect of other variations upon the volume variation. Although it is not yet ascertained what is the extent of these other variations, which arise from changes in selling prices, assortment of goods sold and cost of goods sold, it is evident they have caused a decline in profits, inasmuch as the actual margin is less than the expected margin. It is better to express the volume variation in the values current under the actual conditions, so as to show the amount of profit gained or lost actually against each factor of variation.

A simple calculation will indicate what the results would have been under the existing combination as to sales had the volume variation not occurred:

FIGURE 67

RESULTS HAD VOLUME VARIATION NOT OCCURRED; PRODUCT A (z)

Had volume not increased, sales and costs would have been 95.6% (i.e 110 ÷ 115) of the actual results:

Sales	$52,111
Costs	47,520
Margin	4,591
Actual margin (Fig. 64)	4,800
Gain through increase in volume	$209

(z) Assuming other conditions to be the same.

One variation thus has been set aside. The others may now be discovered. Undoubtedly the price level also changed.

PRICE VARIATION

If the statistics included figures for the quantities sold, the average selling prices of the respective products could be determined and any change in them could be found. But it is now assumed that the variety of products is so great that it is not feasible to keep record of the number of each kind and size of product sold. Then there may be recourse to the total standard cost of goods of this product sold as the means for computing the effect of changed average prices:

FIGURE 68

PRICE LEVEL (AVERAGE)

Actual sales, product A (Fig. 64)		$54,480
Standard cost of goods sold	$46,000	
Ratio standard cost to standard sales (Fig. 63)	80	
Kindred sales ($46,000/80)	57,500	
Average price level		94.748

The standard costs of goods sold can be expanded to their standard sales value on the basis of the proportions in the original budget (Fig. 63). For product A the standard cost of goods sold constitutes 80% of sales. Therefore, the amount of sales corresponding to that in the original budget, but at the current higher volume, can be found by dividing the standard cost of goods sold, $46,000, by 80, the standard percentage of cost of sales. The quotient, $57,500, represents kindred sales. In other words, had average prices for the goods actually sold not changed, the amount of sales would have been $57,500. Because average prices changed, the amount of sales actually is $54,480. The average price level, consequently, is down, and is 94.748%.

But the expected price level is 95 (Fig. 63). The amount of sales expected, $52,250, is for a volume of 110 at a price level of 95, both with regard to the basic budget. So the effect of the change in price level upon profits can be shown by computing the extent of it:

FIGURE 69

PRICE VARIATION (AVERAGE)

Expected price level (Fig. 63)	95
Actual price level (Fig. 68)	94.748
Decrease	.252
Kindred sales (Fig. 68)	$57,500
Average price variation (decline)	*$145*

The decline in the average price level from that expected represents 0.252% of the standard sales dollar. Therefore, the amount of profit lost will be this percentage of the kindred sales for the current volume. To state this another way, the amount of profit lost through a drop in the level of the sales dollar is 0.252%, relative to a volume of 115% of the basic budget. The price variation so calculated shows a decline of $145 in profit. Had the price level not declined, which is to say, had the expected price level of 95 been maintained, the actual profits would have been greater by $145:

FIGURE 70

RESULTS HAD AVERAGE PRICE VARIATION NOT OCCURRED

Sales ($57,500 at 95)	$54,625
Cost (Fig. 64)	49,680
Margin	4,945
Actual margin (Fig. 64)	4,800
Decline through decrease in average price	*$145*

The price variation computed in this way is still a compound amount and, unless further refinement in calculation is undertaken, should be understood to be a price variation on the average. It includes the effect of changes in selling prices, changes in the assortment of goods sold and changes in the proportion of sales (as between trade discount groups). The effect of changes in assortment and proportion upon profits is the same as if the products had been

sold at changed selling prices; if the quantities sold were tabulated and divided into the amounts of sales, a changed average selling price would be found. In cases when assortment and proportion are not subject to much change, further refinement in calculation to bring out the variation in profits from each cause is superfluous. In other cases, the assortment and proportion of sales will fluctuate enough to warrant analysis of the consequent variations in profits. The simpler case will be chosen for the present. The analysis of the assortment and proportion changes will be deferred.

Up to this point in the example, the variation in profits which arose from the increase in volume has been separated from that which arose from the decline in average price. Let us now determine the variation in profits due to changes in costs.

FIGURE 71

COST VARIATION

Expected cost ratio, product A (Fig. 63)	105
Actual cost ratio $\left\{\frac{\$49,680}{46,000}\right\}$ (Fig. 64)	108
Increase	3
Standard cost of goods sold (Fig. 64)	$46,000
Cost variation (decline in profits)	*$1,380*

It will be remembered the ratio of actual to standard costs expected is 105. This may be based on experience as to the trend of costs for product A in the recent past, modified perhaps by judgment as to what are reasonably attainable results, taking into consideration both effectiveness and volume. The goods which, at standard costs, amounted to $46,000, actually cost $49,680, bringing about the cost ratio of 108. There is evidently an increase of three points in costs which applies to all the goods sold. Three points on $46,000 represents $1,380, a decline in profits because costs were higher. Stated conversely, were costs not higher, $1,380 more profit would have been made:

FIGURE 72

RESULTS—HAD COST VARIATION NOT OCCURRED

Sales (Fig. 64)	$54,480
Cost ($46,000 @ 105)	48,300
Margin	6,180
Actual margin (Fig. 64)	4,800
Decline through increase in cost	$1,380

It is plain that had costs stayed at the expected level, 105, the cost of goods sold would have been $48,300 instead of $49,680.

The principal variations in a simple analysis, namely those arising through changes in volume, average prices and costs, have now been ascertained. There remains one other which is incidental to the change in volume.

INCIDENTAL VARIATIONS

It has been explained previously that the volume variation should be shown at the amount gained or lost under prevailing conditions, which is the amount actually at stake. But the present analysis concerns the variations between the actual and the expected results. Therefore, it is necessary to take into account the variation incidental to the change in volume, which arises because the actual conditions as to prices and costs differ from the expected. Had there been no change in average prices or in costs—that is, had these been at expected levels—the volume variation would have been greater; but prices declined on the whole and costs increased, and both of these conditions tend to reduce profits and therefore reduce the gain in profits arising from the higher volume.

The amount involved is simply the difference between the actual and expected margin applied to the increase in volume:

FIGURE 73

INCIDENTAL VARIATIONS

Increase in Standard cost of goods sold (Fig. 66)	$2,000	
Expected margin (Fig. 63) $6,050/$44,000	13.75%	$275
Volume variation at actual profit (Fig. 66)	10.4348	209
Incidental variations		$ 66
Caused by:		
Price decline $2,000 ÷ 80 (Fig. 63) = $2,500 standard sales × .252 (Fig. 69)	6	
Cost increase $2,000 × 3 (Fig. 71)	60	
		66

Had the expected margin of 13.75% on standard costs been realized, the increase in the standard cost of goods sold, $2,000, would have brought in $275 more profit. The actual margin being lower, the corresponding profit is only $209 and the incidental variations are $66. Six dollars of this amount arises from the price decline of a fraction and $60 from the increase of three points in costs.

It will be apparent that setting out the incidental variations is merely separating them from the volume variation. Had this not been done, the volume variation would have been overstated. So far as the figures used in this example go, the difference is not substantial, but it might be so. The separation has the virtue, moreover, as previously explained, of representing the principal variations in amounts actually gained or lost rather than in hypothetical sums.

All the variations accounting for the difference between the expected profits, $6,050, and the actual profits, $4,800, have now been ascertained. It will be helpful to bring the figures together:

FIGURE 74

ANALYSIS OF VARIATIONS IN PROFITS
(Variations in volume, prices and costs)

Expected results				*Actual results*			*Variations*
Standard	*Ratio*	*Expected*	*Product A*	*Actual*	*Standard*	*Ratio*	*in profits*
$55,000	95	$52,250	Sales	54,480	57,500	94.748	
44,000	105	46,200	Cost	49,680	46,000	108	
$11,000		6,050	Margin	$ 4,800	11,500		$1,250
		13.75%	on standard cost	10.4348%			

Volume:	Increase in standard costs	$ 2,000	
	At actual margin 10.4348%		209
Price:	Decrease in price ratio (95 — 94.748)	.252%	
	Kindred sales	$57,500	145
Cost:	Increase in cost ratio (105 — 108)	3%	
	Standard cost of goods sold	$46,000	1,380
Incidental variations:			
	Volume: Decrease in actual margin— 3.3152% × $2,000		66
			$1,250

The analysis discloses that, although there have been changes in all three prime factors of variation, the decline in profits is substantially attributable to the cost variation. The difficulty to be remedied is one of manufacture and not one of sale. Costs must be reduced or products modified to accomplish the same end, especially as relief through higher prices evidently is not imminent. The situation where volume and price are concerned is according to expectations. The only direction in which betterment can be sought is toward lower costs; and, therefore, no time need be wasted in arguing for alternative courses of action. Were the circumstances otherwise, the figures would indicate the facts.

It may be worth mentioning at this point, that the object of this analysis (and the same may be said of all analyses in modern industrial accounting) is not to indicate by figures the remedy for unfavorable conditions, but to single out and show clearly the directions in which remedial measures properly applied will be most effective. It is easy to imagine an executive officer at this point remarking that these calculations are all very good and the results are interesting, if true, and then asking, "What is to be done about it? The conditions are what they are and no figure-spinning can change them!" It is true enough, unfortunately, that even the most lucid figures will not of themselves transform wrong trends into desired effects. Were it not so, we should have no business depressions. But it is rather futile to decry the limitations of human knowledge and at the same time to deny a promising means of overcoming them somewhat. The benefit to be derived, which is the object of making such analyses, is a better and more accurate knowledge of what is going on in the business, in the hope that, through such knowledge, technical skill and judgment may be employed to bring about better results. If the analysis serves for nothing more, it may at least make clear the inconsistency of maintaining that conditions can not be changed while expecting profits incommensurate with those conditions.

CHAPTER X

ANALYSIS OF VARIATIONS IN PROFITS ON THE BASIS OF STANDARD COSTS (*Continued*)

Assortment Variation

Reference has been made to the fact that, in the simple analysis above described, the price variation is an average, including the effect also of any change which may have occurred in the assortment of products sold. A class of products covering numerous articles in the same general category but of different grades, sizes or styles, usually can not be sold at selling prices affording the same margin of profit on every article. The profit margin on the whole class is the average resulting from sales in existing proportions as between products, that is to say, in the current assortment of the articles making up the class. If, in a given period, this assortment varies so that a larger proportion of the articles in the class carrying narrower margins is sold, the effect will be the same as if the average selling price had come down, and vice versa. In many instances, it is desirable to separate the assortment variation from the price variation. These may not only vary disproportionately, but also may tend in opposite directions at the same time.

In order to isolate the assortment variation, it is necessary to price the articles sold at their standard sales prices, which are the same prices as were used in establishing the original basic budget—information that is readily obtainable. Then the difference can be found between the standard sales amount for the goods actually sold and the amount of kindred sales (kindred sales being the standard sales which would have occurred had the products been sold in the standard assortment):

Figure 75

ASSORTMENT OF PRODUCTS SOLD
Class A

Goods sold, priced at standard sales prices; standard sales	$56,750
Kindred sales ($46,000/80; Fig. 63)	57,500
Assortment ratio	98.7 (98.6956)

Assuming, for the sake of illustration, that the goods sold of class A were priced at standard sales prices aggregating $56,750, it becomes apparent that the assortment of products sold has been such as to reduce the margin on the whole, because if this had not been so, the amount of sales would have been $57,500. In other words, the goods sold, which at standard costs came to $46,000, would have had a standard sales value of $57,500 ($46,000/80); whereas the standard sales value of these goods is only $56,750, indicating that among them are articles for which the selling prices are closer to costs, and that more of such articles proportionately are in the current sales. The assortment ratio can be expressed as the relation between standard sales and kindred sales—in this case 98.7.

It will usually be the expectation to sell the standard assortment of merchandise. It is assumed in this example that that is the case, although there is no reason why a different level of expectation may not be used. The amount of the variation in profits which arose from the change in assortment can now be set out:

Figure 76

ASSORTMENT VARIATION

Standard sales product A (Fig. 75)	$56,750
Standard cost of goods (Fig. 74)	46,000
	$10,750
Margin (at standard) on standard costs	23.37%
Expected margin (at standard) (Fig. 63)	25.00

Decrease in standard margin	$750(a)	1.63%
Actual price level (Fig. 78)	96(b)	
Assortment variation, decline		$ 720

Notes:
(a) 1.63 × $46,000.
(b) $\frac{\text{Actual sales } \$54{,}480}{\text{Standard sales } 56{,}750} = 96$ (Fig. 78)

The margin actually realized, in percentage upon standard costs, is 23.37%. This is the standard margin for the assortment of goods actually sold. The expected margin is 25% of standard costs. The latter is the standard margin on goods sold in the standard assortment. There is evidently a decrease in the standard margin of 1.63%, due solely to the change in assortment. Had the standard cost of goods sold, $46,000, been on products in the standard assortment, the standard sales value of them would have been 1.63% greater, which is equal to $750; that is to say, standard sales and kindred sales then would have been the same, $57,500. This decrease of $750 in the level of the standard sales dollar, however, has a value of only 96% under actual conditions, because the actual price level is 96 (see Fig. 78). Consequently, the assortment variation shows a decline of $720.

Seven hundred and twenty dollars is the amount actually lost in profits because sales were composed of an assortment normally less profitable. Had the same volume of sales been composed of goods in the standard assortment, the profits would have been $720 greater:

FIGURE 77

RESULTS HAD ASSORTMENT OF PRODUCTS SOLD NOT CHANGED

Sales ($57,500 @ 96)	$55,200
Cost (Fig. 64)	49,680
Margin	5,520
Actual margin (Fig. 64)	4,800
Decline through variation in assortment	$ 720

The segregation of the variation in profits due to assortment discloses that the price level actually is 96 instead of 94.748, as it previously appeared to be. Selling prices which were maintained at 96 on the average seemed lower because of the depressing effect of a less profitable assortment. The price variation now shows a gain in profits:

FIGURE 78

PRICE VARIATION (a)

Actual sales, product A (Fig. 64)	$54,480
Standard sales, for goods actually sold (Fig. 75)	56,750
Actual price ratio	96
Expected price ratio (Fig. 63)	95
Increase	1
Price variation (1 × $56,750) — gain	$ 568

Note: (a) actual.

Current profits were enhanced $568 because a slightly better price level was realized. Had this not been accomplished, i.e., had the expected price level of 95 obtained, the actual sales dollars would have been less to the extent of 1 point; the actual sales amount, $54,480, would have been only $53,912—less by $568.

Before the separation of the assortment variation, it was found that the average price variation was a decline in profits of $145. It is now found that the assortment variation has caused a decline of $720, offset by a gain from the price variation of $568—in the net, a decline of $152. This is $7 more than was previously computed. The difference arises from the price variation incidental to the assortment variation. Had the assortment been standard, the price variation would have been $575, but inasmuch as the assortment declined in profitableness, that is to say, brought in fewer sales dollars, the price variation is reduced to the extent of 1% on the decrease in assortment, which is, in round figures, $7.

The price variation could have been shown in the first place as $575 instead of $568, but as in the case of the volume variation, this would not represent the actual gain; merely the gain had the assortment been standard. Therefore, the incidental variation is better shown separately.

To recapitulate, the analysis now stands including the assortment variation:

FIGURE 79

ANALYSIS OF VARIATIONS IN PROFITS
(Variations in volume, assortment, prices and costs)

Basic budget	*Expected results*		*Product A*	*Actual*	*Actual results*		*Variations in profit*
Standard	*Ratio*	*Amount*			*Standard*	*Ratio*	*Decline*
	110		Volume			115	
$50,000	95	$52,250	Sales	$54,480	56,750	96	
40,000	105	46,200	Cost	49,680	46,000	108	
$10,000		6,050	Margin	$ 4,800	10,750		*$1,250*
25%		13.75%	on standard cost	10.4348%	23.37%		

Volume:	Increase in standard costs (5 × $40,000)	$ 2,000	
	Actual margin 10.4348%		209
Assortment:	Decrease in standard margin	1.63%	
	On standard cost of sales $46,000 =	$ 750	
	At actual price level 96%		*720*
Price:	Increase in price level (95-96)	1%	
	On standard sales $56,750		568
Cost:	Increase in cost ratio (105-108)	3%	
	Standard cost of sales	$46,000	*1,380*
Incidental variations:			
	Volume: Decrease in actual margin 3.3152% × $2,000	66 [1]	
	Price: Decrease in assortment $750; price variation 1%	7	73
			$1,250

Assortment ratio 98.7 ($56,750: $57,500)

[1] Assortment 1.63 × 95 × $2,000 ..... *$31*
Price 1 × 123.37 × $2,000 25
Cost 3 × $2,000 ..... *60*
$66

All the variations which combine to bring about the net result of a decline in profits of $1,250 from the expected amount have now been resolved. The most prominent variation is that arising from the increase in costs. The remaining unfavorable trend is the decline in the profitableness of the assortment of goods sold. The less profitable articles are selling more easily, or what is more probable, a "leader" in the class is being sold without fulfillment of the expectation that it will stimulate the sale of other products. Clearly the two matters requiring attention are costs and assortment. If these can be brought back in line with expectations, the expected profit will be realized and if the existing conditions as to price and volume are maintained, the expected profit will be exceeded.

Thus the analysis correctly sets forth the effect of each variation upon profits. This is readily proved by making calculations for each possible combination of circumstances (as has already been done in preceding pages for certain of them: Figures 67, 70, 72, 77). Inasmuch as such calculations are of interest only to indicate that the expression of variations in this manner is correct, further space is not taken here to display them. A complete set of calculations showing the actual profits under the various combinations of circumstances is given in the appendix.

It will be more profitable to review the principles which have been explained by proceeding to analyze variations in profits for the remaining products B, C and D, assuming other conditions. In the example dealing with product A, it has been assumed that all the factors of variation have been active. Let us now assume a case in which one of the factors does not vary and the others change but not as in the case of product A.

FIGURE 80

ANALYSIS OF VARIATIONS IN PROFITS
(Variations in volume, assortment and prices; costs unchanged)

Basic budget	*Expected results*			*Actual results*			*Variations*
Standard	*Ratio*	*Amount*	*Product B*	*Actual*	*Standard*	*Ratio*	*in profits*
	123.5		Volume			90	
$70,000	98	$84,700	Sales	$61,047	64,260	95	
59,500	101	74,200	Cost	54,085	53,550	101	
$10,500		10,500	Margin	$ 6,962	10,710		*$3,538*
17.6478%		14.29%	on standard cost	13%	20%		

Volume:	Decrease in standard costs (33.5 × $59,500)	$19,915	
	Actual margin	13%	*2,588*
Assortment:	Increase in standard margin	2.3522%	
	On standard cost of sales $53,550 =	$ 1,260	
	At actual price level 95		1,197
Price:	Decrease in price level (98-95)	3%	
	On standard sales $64,260		*1,928*
Cost:	Unchanged		
Incidental variations:			
	Volume: Decrease in actual margin 1.29% × $19,915	$ 257	
	Price: Increase in assortment $1,260; price variation 3%	38	*219*
			$3,538

Assortment ratio 102 ($64,260 ÷ $63,000)

In this example for product B it is assumed that costs remain unchanged, or in other words, the cost ratio expected, 101, was realized. The volume of sales, on the other hand, substantially decreased, being 90 instead of 123.5. The assortment has changed to a slightly more profitable one than expected, the assortment ratio being 102.

But prices have declined, the price level being 95 instead of 98.

The decline in volume carries with it a decline of $2,588 in profits, on the basis of the actual margin of 13%. The increase in assortment has brought about an increase in the standard margin from 17+% to 20%, causing a gain in profits of $1,197. The increased assortment having been sold at lower prices, however, caused a corresponding decline of three points on all that was sold, amounting to $1,928. Finally, the incidental variations running with volume and price account for a change in profits amounting to $219. The sum of these amounts agrees with the net decline in profits of $3,538 from the expected amount.

In this example, the volume and price trend are the unfavorable ones; costs are unchanged and the assortment is more profitable. If the decline in price level was permitted in the expectation of obtaining an increased volume, the expectation was not fulfilled.

As in the previous example, the amounts of the variations are expressed in current values—that is to say, they represent the amounts by which the actual profit would have been greater or less had each variation not occurred, with the others remaining unchanged:

FIGURE 81

COMPUTATION SHOWING RESULTS HAD VARIATIONS NOT OCCURRED

	P *Price unchanged*		*A* *Assortment unchanged*		*V* *Volume unchanged*
Ratio to basic budget:					
a V	90	a V	90	e V	123.5
a A	×102	e A	×100	a A	×102
sS	91.8	sS	90	sS	125.95
e P	× 98	a P	× 95	a P	× 95
SL	89.964	SL	85.5	SL	119.64
Amounts:					
Sales	$62,975		59,850		83,750
Cost	54,085		54,085		74,200

a = actual
e = expected
sS = standard sales
SL = sales level

	P *Price unchanged*	*A* *Assortment unchanged*	*V* *Volume unchanged*
Amounts:			
Margin	8,890	5,765	9,550
Actual margin	6,962	6,962	6,962
Variation	*$ 1,928*	1,197	*2,588*

These brief calculations show that the analysis of the variations which combined to produce the net result in actual profits is correct. It will be especially interesting to observe the manner in which the results under various assumptions can be projected by means of ratios as will be done later. Let us first proceed to analyze the variations which occurred in the case of product C.

FIGURE 82

ANALYSIS OF VARIATIONS IN PROFITS

(Variations in volume, assortment and costs; price unchanged)

Basic budget Standard	*Expected results Ratio*	*Expected results Amount*	*Product C*	*Actual*	*Actual results Standard*	*Actual results Ratio*	*Variations in profits*
	80		Volume			88	
$130,000	105	$109,200	Sales	$115,315	109,824	105	
117,000	96	89,856	Cost	101,930	102,960	99	
$ 13,000		19,344	Margin	$ 13,385	6,864		*$5,959*
11.11%		20.66%	on standard cost	13%	6.66%		

Volume:	Increase in standard costs (8 × 117,000)	$ 9,360	
	Actual margin	13%	1,217
Assortment:	Decrease in standard margin	4.444%	
	Standard cost of sales $102,960 =	$ 4,576	
	Actual price level 105		*4,805*
Price:	Unchanged		

Cost:	Increase in cost ratio (96 — 99)	3%	
	Standard cost of sales	$102,960	*3,089*
Incidental variation:			
	Volume: Decrease in actual margin 7.66% × $9,360		718
			$5,959

$$\text{Assortment ratio} = 96 \left\{ \frac{109{,}824}{88 \times 130{,}000} \right.$$

Here is a case in which the price level is assumed to be unchanged. It was expected that prices could be held at a level of 105, and this was accomplished. Moreover, an increase in volume was attained at the same time. A partial explanation may lie, however, in the assortment trend. While prices were maintained and a greater volume was sold, the products involved were of a much narrower profit margin, to an extent far exceeding the gain in volume. Costs also show a substantial increase. The picture as a whole indicates a lack of balance in the proportions or an error in expectations.

The figures in this example well illustrate the importance of separating the incidental variations, especially as to volume. Had this not been done, the volume variation, computed on the basis of the expected profits, would have shown a gain of $1,935. Actually the variation is only $1,217 gain, owing to the heavy unfavorable trends in assortment and costs.

Previous examples have included a case in which all of the factors varied, one in which costs were unchanged and one in which prices were unchanged. As a final illustration, let us assume for product D that volume and assortment remain unchanged and variations in prices and costs only are disclosed:

FIGURE 83

ANALYSIS OF VARIATIONS IN PROFITS

(Variations in prices and costs; volume and assortment unchanged)

Standard	*Expected results* *Ratio*	*Amount*	*Product D*	*Actual results* *Actual*	*Standard*	*Ratio*	*Variations in profits*
	90		Volume			90	
$50,000	97	$43,650	Sales	$44,100	45,000	98	
37,500	94	31,725	Cost	30,375	33,750	90	
$12,500		11,925	Margin	$13,725	11,250		$1,800
33.33%		35.33%	on standard cost		33.33%		
Volume:	Standard costs unchanged...						
Assortment:	Standard margin unchanged						
Price:	Increase in price level (97-98)				1%		
	Standard sales				$45,000		450
Cost:	Decrease in cost ratio.....				4%		
	Standard cost of sales.....				$33,750		1,350
							$1,800

The analysis now presents the happy condition that sales were made in the expected quantities and of the expected character of merchandise, but at increased prices and decreased costs. The situation is satisfactory, although there is room for consideration, if the product has a wider market and the decrease in costs is permanent, whether price concessions, in view of the wide profit margin already enjoyed, can be made to enlist substantial increases in volume.

PROPORTION VARIATION

The underlying factors of variations which have been considered are those usually present, for which it will be desired to analyze variations in profits. There is another factor of importance that will be found in any business in which sales are made of the same merchandise at different selling prices to different trade groups of customers. In such cases, the assortment variation will be influenced by any deviation from the expected proportions in sales as between

the respective customer groups—for instance, as between jobbers and dealers. The variation in profits from this cause can be separated. To explain how this is done, let us assume that product A is sold to jobbers and dealers and the following budget has been established:

FIGURE 84

BUDGET OF SALES AND PROFIT MARGINS

Jobber-dealer sales

Product A	*List*	*Standard* %	*Net*	*Expected results* *Amount*	*Level*	
Sales to jobbers	$60,000	60	$36,000	37,620		
Sales to dealers	15,555	90	14,000	14,630		
Total sales	$75,555	66.177	50,000	52,250	95	price
Sales		100				
Cost		80	40,000	46,200	105	cost
Margin		20	$10,000	6,050		
Volume					110	volume

The sales to jobbers are made at a discount of 40%, whereas those to dealers are at a discount of 10%. The proportions of net sales are expected to be 72% to jobbers and 28% to dealers. In these proportions the net sales of $50,000 are expected to be made at an average discount on the whole of a little over 1/3. It will be evident that any change in the proportions of sales as between jobbers and dealers will change this average discount and, in that way, change the level of net sales. Let us assume all other conditions as to product A are the same as in the previous analysis, both as to expected and actual results, but that a change has occurred in the proportion between sales to jobbers and those to dealers:

FIGURE 85

PROPORTION VARIATION

Actual results

Product A	*List*	%	*Standard Sales*	*Price*	*Actual Sales*
Jobbers	$72,404	60	$43,442	96	$41,704
Dealers	14,786	90	13,308	96	12,776
Total	$87,190		56,750	96	54,480

Standard sales in standard proportions:		
List	$87,190	
Net (at average discount, Fig. 84)	66.177%	$57,700
Standard sales in actual proportions (above)		56,750
Proportion variation, decline		950
At actual price level		× 96
Variation in profit from expectations		$912

It is necessary in isolating the proportion variation to have at hand figures showing sales at list prices. This information is usually available in such cases. It is found that the sales at list prices, when extended at the average discount expected in the basic budget, should yield kindred sales of $57,700, whereas it is known, as previously explained, that the standard sales value of the goods sold is $56,750. The first amount represents standard sales in the standard proportions; the second amount represents standard sales in the actual proportions. Any difference between them is a variation due solely to a change in proportion, arising from the change in average standard discounts. In this example, the proportion variation shows a decline of $950, that is to say, standard discounts were greater to this extent because a greater share of current sales was made to jobbers than to dealers. This decline has an actual current dollar value of 96, the actual price level, and therefore the net variation is a decline of $912, because more sales were made to jobbers.

This variation affects the assortment variation. In other words, when the additional feature of sales to diverse classes of customers is

FIGURE 87

VARIATIONS IN COMPOSITION OF SALES, AS WELL AS IN VOLUME, ASSORTMENT, PRICES AND COSTS

Basic budget standard	*Expected results* Ratio	*Amount*	*Product A*	*Actual results* Actual	Standard	Ratio	*Variation*
	110		Volume			115	
$36,000	95	$37,620	Jobbers	$41,704	$43,442	96	
14,000	95	14,630	Dealers	12,776	13,308	96	
50,000	95	52,250	Total sales	54,480	56,750	96	
40,000	105	46,200	Cost	49,680	46,000	108	
$10,000		6,050	Margin	$4,800	10,750		*$1,250*
25%		13.75%	% on standard cost	10.4348%	23.37%		
$75,555			Sales at list	$87,190			
66.177%			Equivalent standard sales		$57,700	66.177	

Volume:	Increase in standard costs (115 — 110 × $40,000)			$2,000	
	Actual margin 10.4348				209
Proportion:	Decrease in standard sales ($57,700 — $56,750)			950	
	Actual price level			96%	*912*
Assortment:	Decrease in standard margin	1.63%			
	Standard cost of sales	$46,000	=	750	
	Less proportion decline included			950	
	Gain in assortment			200	
	Actual price level			96%	192
Price:	Increase in price ratio (95 — 96)			1%	
	Standard sales			$56,750	568
Cost:	Increase in cost ratio (105 — 108)			3%	
	Standard cost of sales			46,000	*1,380*
Incidental variations:	Volume: decrease in actual margin 3.3152% × $2,000			66	
	Price: decrease in assortment and proportion $750 × 1%			7	73
					$1,250

introduced, the analysis of variations in profits shows a gain in the assortment variation, inasmuch as the decline of $912 due to proportion is included in the previous net assortment loss of $720; consequently, the assortment variation must have been the difference, a gain of $192:

FIGURE 86

PRODUCT A

Assortment variation

Standard sales in standard proportions (Fig. 85)		$57,700
Basic budget	$50,000	
Actual volume (Fig. 65)	115	
Kindred sales, i.e., standard sales in standard assortment (Fig. 68)		57,500
Assortment variation, gain		200
At actual price level (Fig. 78)		× 96
Variation from expected profit, gain		192

It is now known that standard sales, in the standard proportions but in the assortment of products actually sold, would have come to $57,700, whereas kindred sales (which are standard sales in the standard assortment) amount to $57,500. The difference, which is entirely due to the change in assortment, is a gain of $200; which, as before, must be taken at the current actual price level of 96, showing a favorable variation from expected profits of $192.

The analysis of variations in profits for product A, which now includes a change in composition of sales as well as changes in volume, assortment, prices and costs, may be summarized as shown in Fig. 87.

The calculations differ little from those previously made, except for the additional information regarding sales at list, which is essential as the basis for ascertaining the difference between the average discounts allowed and expected. (Sometimes the variation in volume is computed on the basis of list values, when these are present, instead of on the basis of standard costs. The result is slightly differ-

ent then as to the amounts of the volume, proportion and assortment variations.)

To prove the correctness of calculation of the proportion variation, it will be of interest to show what the results would have been had this variation not occurred:

FIGURE 88

COMPUTATION SHOWING RESULTS HAD EXPECTED JOBBER-DEALER SALES PROPORTIONS OBTAINED

	Volume = 115.4			
	List	*%*	*Net*	
Sales:				
Jobbers	$69,240	60 @ 96	$39,882	price = 96
Dealers	17,950	90 @ 96	15,510	
	$87,190		$55,392	
Cost			49,680	cost = 108
Margin			5,712	
Actual margin (Fig. 87).....			4,800	
Decline through change in proportion between jobber and dealer sales			$ 912	

SUMMARY OF VARIATIONS IN GROSS PROFITS

The several calculations entering into the analysis of variations in profits have now been made. In the endeavor to make clear the principles involved, the calculations have been set forth in full detail. It will be understood that in practice the figures would not be presented at such length. The precise form that will be best in each instance is obviously subject to the conditions and requirements. The essential features are a summary of actual and expected results and an analysis of the variations between them, according to the underlying factors of importance. A summary of the figures which have been used is given in Fig. 89.

No attempt will be made here to discuss the minutiæ of procedure for obtaining the figures, inasmuch as no general procedure could be universally adopted. Few difficulties need be encountered in obtaining the information, once the theory of the calculations is

FIGURE 89

ANALYSIS OF VARIATIONS IN PROFITS

Summary

	Product A		*Product B*		*Product C*		*Product D*		*Total*	
	Amount	*Ratio*	*Amount*	*Ratio*	*Amount*	*Ratio*	*Amount*	*Ratio*	*Amount*	*Ratio*
Actual:										
Sales	$54,480	96	$61,047	95	$115,315	105	$44,100	98	$274,942	
Cost	49,680	108	54,085	101	101,930	99	30,375	90	236,070	
Margin	$ 4,800		$ 6,962		$ 13,385		$13,725		$ 38,872	
Volume		115		90		88		90		
Expected:										
Sales	$52,250	95	84,700	98	109,200	105	43,650	97	289,800	99.8
Cost	46,200	105	74,200	101	89,856	96	31,725	94	241,981	99.3
Margin	$ 6,050		$10,500		$19,344		$11,925		$47,819	
Volume		110		123.5		80		90		96.4
Variations in profits.....	$ 1,250		$ 3,538		$ 5,959		$ 1,800		$ 8,947	
Analysis:										
Volume	209		2,588		1,217				1,162	
Proportion	912								912	
Assortment	192		1,197		4,805				3,416	
Price	568		1,928				450		910	
Cost	1,380				3,089		1,350		3,119	
Incidental										
Volume	66		257		718				527	
Price	7		38						45	
	$ 1,250		$ 3,538		$ 5,959		$ 1,800		$ 8,947	

understood. The essential figures are standard costs coupled with a budget of expectations. When the assortment variation is to be shown, standard sales must be computed; and when the proportion variation is also to be shown, list values of sales are needed. The machinery for obtaining such figures is manifold and it is merely a matter of ingenuity to keep clerical work at a minimum.

The analysis of variations in profits should be made monthly and should form a regular part of the financial statements. The information disclosed may be made most useful in guiding the business, curtailing unfavorable trends and, perhaps, extending the favorable ones. The separation of the variations by causes for each class of products is helpful in eliminating from consideration conditions which, for the time being, are in good order, thus focusing attention upon the remainder. For example, in the hypothetical figures (Fig. 89) it is found that, on the whole, products C and B show the poorest results. For product C the assortment needs to be increased and costs need to be reduced. For product B more volume is needed; indeed, if prices can not be stiffened, there must be substantially more volume. For product A costs might be investigated to advantage, and it might also be ascertained why the proportion of sales to dealers has dropped off. For product D thought might be given to plans for extending the favorable results already shown.

Information of this kind becomes more valuable as it accumulates. It will be evident that the figures can be arranged in a manner to bring out the trends of these variations monthly. Then the rate and direction of progress as to each class of products and each factor affecting profits can be seen.

CHAPTER XI

PROJECTION OF RESULTS UNDER EXPECTED CHANGED CONDITIONS

The several ratios which have been obtained in the foregoing calculations can be used with ease to calculate how profits will be affected by changes in the conditions as to prices or volume or costs —in fact as to all of them in any probable combination. The figures in the basic budget form the background for the calculations. In Fig. 33 these were shown, for class A, to be:

BASIC BUDGET, PRODUCT A
Standard

Sales	$50,000	100%
Cost	40,000	80
Margin	$10,000	20%

Suppose the inquiry is made, what will be the amount of sales at a price level of 95 if a volume of 110 is maintained? To find the answer one may apply the product of the volume and price ratios to the basic standard sales. It will be recalled that net sales are composed of the two variables, volume and price (average price). Net sales under the stated conditions then would be $95 \times 110 = 104.5$ of $50,000, or $52,250. To put this in diagram form:

FIGURE 90

Known		*Sought*
Volume	110	Amount of
Price	95	net sales
Volume	110	
Price	95	
Sales	104.5 × $50,000 = $52,250 net sales	

In making projections as to probable results, it will usually be assumed that sales will be in the standard assortment, so that allowance for an assortment variation need not be made. Should such an allowance be desired, it can be made. Then the amount of net sales will be to the basic budget at a ratio which is the product of volume × assortment × price. Assuming the question to be: What will be the amount of net sales at a price level of 96 and a volume of 115 if the assortment of goods sold is 98.7? the answer would be found thus:

FIGURE 91

Known		*Sought*
Volume	115	Amount of
Assortment	98.7	net sales
Price	96	
Assortment	98.7	
Price	× 96	94.748
Volume	× 115	
Sales		108.96 = $54,480 net sales

These are the figures which were used in the previous examples for the actual conditions, except omission of the proportion variation. The proportion variation may be introduced like that for assortment, although, again, in projections it is probable that the standard proportions will be assumed.

The actual results (Fig. 89) indicate a price level of 96, off 4 points from standard. Let us assume the question is asked: What will be the consequence of restoring the price level to standard? Naturally this may be at the sacrifice of some volume. How much will be the profit if the price level is brought back to 100 and it is expected that the volume will fall off from the present level of 115, say also to 100? It is necessary to take into account the level at which costs may be expected to stand; this, say, is 105. The query then is: What will be the amount of profit with prices and volume at 100 and costs at 105?

FIGURE 92

Known		*Sought*
Price	100	Amount of
Volume	100	profit
Cost	105	
Price	100	
Volume	× 100	
Sales	100	
Cost (80 × 105)	84	
	16% = $8,000	

Proof:

Sales	$50,000
Cost	42,000
Margin	$ 8,000

As price and volume are both at par, the amount of sales will equal the standard sales in the basic budget. The costs at a level of 105 will be at the same ratio to the costs in the basic budget. For simplicity in calculation, the cost level is transposed into a ratio to standard sales: 80% at 105 would be 84%. With sales at 100, this leaves a margin of 16%, or $8,000. It is clear from this calculation that, if these conditions can be brought about, the profit will be greater than it actually was, better even than it was expected to be for a larger volume at a reduced price. A good policy would be to maintain the price and relinquish some volume, provided the volume does not drop off more than estimated.

On the other hand, the actual figures show a volume of 115 and a price of 96, and it might be the opinion of the management that the volume could be still further increased. It might be felt that with stimulated sales activity in certain directions, the volume of 115 could readily be brought up to 125. The question then occurs at what price this volume must be sold in order to yield a certain profit, say, the full profit in the basic budget, $10,000. As to costs, it will be assumed that, in the light of experience and to be conservative, they should be estimated at a cost ratio of 106. The answer sought, then, is, at what price level sales must be maintained for a

volume of 125, with costs at 106, to yield $10,000 profit. The calculation is as follows:

FIGURE 93

Known		*Sought*
Volume	125	Price level, to yield
Cost	106	a profit of $10,000
Actual costs (80 × 106 × 125)		106
Desired margin (standard)		20
Volume)sales		125)126
price		100.8 necessary price

Proof:

Sales	$63,000
Costs	53,000
Margin	$10,000

In the premises, actual costs will be 80% of standard sales at a ratio of 106 for 125% of the volume. Therefore, in percentage to standard sales, actual costs will be 106, (80 × 106 × 125). The desired profit, $10,000, represents 20% on standard sales. This percentage must be added to that for actual costs to obtain the sales level. Sales, therefore, must be 126% of standard.

It is known that this ratio is the product of the volume and the price ratio. Hence, if we divide 126 by the volume ratio, 125, we ascertain that the necessary price level is 100.8. In other words, prices must be maintained about at par if the desired profit is to be realized.

Again, it might be the opinion of the management that prices are at their maximum and there is little hope of increasing them. It might be the belief that some increase in volume could be obtained, but that prices must remain fixed where they are; also that costs are like to be at a level of 106. The question then may be asked: How much volume must be obtained with prices at 96 and costs at 106, to yield a profit of $10,000? The answer is a volume of 178.6, found as follows:

FIGURE 94

Known		*Sought*
Price	96	Volume, to yield a profit
Costs	106	of $10,000
Price		96
Costs (80 × 106)		84.8
Margin)standard		
margin		11.2%)20%
volume		178.6 necessary volume

Proof:

Sales	$85,715
Costs	75,715
Margin	$10,000

With prices at 96, and costs at 106, which, having a weight of 80, is equivalent to 84.8, the margin on sales would be 11.2%. The desired margin which would lead to the profit of $10,000 is 20%, which is 1.786 times the margin of 11.2%. In other words, in these proportions, it will be necessary to sell more than 1¾ times as much merchandise in order to earn a profit of $10,000.

The possibility of a reduction in costs has not been considered. It might be that some improvement could be brought about by altering ingredients or processes which would lower the cost ratio. Then, assuming that the price level must stand at 96 but that a volume of 125 is deemed possible, the question might take the form: To what level must costs be reduced with a volume of 125, with prices at 96, to yield a profit of $10,000? The answer by calculation is that under these conditions costs must be brought to a level of 100, i.e., where actual costs equal standard:

FIGURE 95

Known		*Sought*
Price	96	Cost, to yield a profit
Volume	125	of $10,000

	Price		96
	Desired margin		
		(20/125)	16
Standard cost %	Cost %	80%	80%
	Cost ratio		100 necessary cost ratio

Proof:

Sales	$60,000
Costs	50,000
Margin	$10,000

If the desired margin is subtracted from the price level of 96, the percentage of the standard sales dollar which remains to cover costs is obtained. The desired margin is 20% at standard, but owing to the increased volume contemplated it need be less to yield the desired profit. At the volume 125, a margin of 16% on standard sales will amount to $10,000 (20÷125). The subtraction of the desired margin of 16 from the price 96 leaves 80 as the percentage of the standard sales dollar available for costs, which is precisely the level set in the basic budget as standard. Actual costs, therefore, must be equal to standard costs in order to yield a profit of $10,000. The cost ratio must be reduced to 100.

It will be apparent from the foregoing examples that in making these calculations the expedient of transposing the ratios on the various trends into percentages of the standard sales dollar is adopted. It is then readily possible to ascertain the effect upon profits of the three variables, price, volume and cost, in a given combination, or to find out what any one of them must be when the other two are known or assumed to be in a certain relationship. The rules for making the calculations can be set down simply:

To find COST:

	Example:
PRICE RATIO	96
less: DESIRED MARGIN divided by VOLUME RATIO	20 ÷ 125 = 16
STANDARD % COST TO SALES) % COST TO SALES	80) 80
COST RATIO	100

To find VOLUME:

	Example:
PRICE RATIO	96
less: COST RATIO times STANDARD % COST TO SALES	106 × 80 = 84.8
MARGIN) STANDARD MARGIN	11.2) 20
VOLUME RATIO	178.6

To find PRICE:

COST RATIO times VOLUME RATIO times STANDARD % COST TO SALES	106 × 125 × 80 = 106
plus: DESIRED MARGIN	20
VOLUME RATIO) SALES RATIO	125) 126
PRICE RATIO	100.8

To find AMOUNT OF PROFIT:

	Example:
PRICE RATIO times VOLUME RATIO	100 × 100 = 100
less: COST RATIO times STANDARD % COST TO SALES	105 × 80 = 84
MARGIN	16
times: STANDARD SALES (Budgeted)	$50,000
PROFIT	$8,000

It should be unnecessary to recapitulate what has been said regarding the projection of results. It may be more helpful to present another example of similar calculations following the above rules. Product "D" will be selected:

BASIC BUDGET, PRODUCT D

Sales	$50,000	100%
Cost	37,500	75
Margin	$12,500	25%

Q: What will be the amount of *profit* on sales with volume at 100, prices at 95 and costs at 95?

A: $95 \times 100 = 95$
$95 \times 75 = 71.25$
23.75
$\times \$50{,}000 = \$11{,}875$ q. e. f.

Proof:

Sales	$47,500
Cost	35,625
	$11,875

Q: What *price* is needed to yield a profit of $15,000 with volume at 110 and costs at 92?

A: $92 \times 110 \times 75 = 75.9$
$\$15{,}000/\$50{,}000 = 30.0$
$110)\ 105.9$
(96.27) 96 q. e. f.

Proof:

Sales	$52,950
Cost	37,950
	$15,000

Q: What *volume* is needed to yield a profit of $12,500 with price at 94 and costs at 90?

A: $90 \times 75 = 67.5$
$26.5)\ 25$
(94.34) 94 q. e. f.

Proof:

Sales	$44,340
Cost	31,840
	$12,500

Q: What *cost* level will yield a profit of $15,000 with volume at 105 and price at 93?

A: $30 \div 105 = 28.6$
$75)\ 64.4$
85.9 q. e. f.

Proof:

Sales	$48,825
Cost	33,825
	$15,000

CHAPTER XII

OUTLINING THE ACCOUNTING PLAN; CLASSIFICATION

The first essential in approaching an outline of the accounting plan is recognition of the fact that standard costs and standard cost accounting are not merely expedients accessory to some other and principal accounting system. Sometimes they are mistakenly regarded as adjuncts or supplementary features for the purpose of obtaining some additional advantages of comparison. The fundamental plan then is held to be an indispensable process-cost system or job-order cost system, with standard costs superimposed thereon, presumably at an added cost for those who can afford it.

Such a belief is discordant with a full understanding of the objects and methods of using standard costs. Standard costs are not only an integral part of the accounting plan: the standard cost plan is an essentially different plan. The standard cost plan has little in common with the job-order cost plan. It is more similar to the process-cost system, in that costing parallels processes. The main objects are to ascertain effectiveness in performance, by processes, and variations in effectiveness from what should be accomplished, separately for the two functions of spending and producing which are incident to the processes. These objects are defeated, or at least analysis is made more difficult, by spreading the figures among job cost sheets which are in another classification entirely—that of pieces manufactured by lots. The information is more significant when classified by processes and functions, according to departments or other suitable grouping following lines of responsibility for results.

When this view is accepted, there is no question whether the standard costs should be "tied in" with the accounts or kept as collateral statistics. Under either method of their use, as ideal standards or as basic standards, the standard costs must enter into the accounts, and the accounting plan must be specially devised for their incorporation.

Inasmuch as no two cases are exactly alike, the accounting plan will be different for each installation. This means that a careful study must be made of the products manufactured and their methods of manufacture and shipment. The study must cover all operating conditions within this scope. It should be sufficiently comprehensive to provide a thorough knowledge of what products are made and how they are made. But it is appropriate to add that this study does not require an extensive analysis and review of the entire business, its organization and reason for being, its financial structure and its personnel—in a word, of all the complex phases of its business character and economic destiny. If this be exaggeration, let it serve the purpose of emphasis in sounding the warning that the establishment of the standard cost plan does not require excursions into questions of method, organization or policy that would be more properly the subject of separate study. Possible changes and improvements in these should not be related to the adoption of standard costs, which after all, are to be used for measuring existing conditions. Yet there is a tendency to deem it necessary to go into sources and the methods of procuring raw materials; the conditions as to the labor market and labor shortage; possibilities for improvement in manual technique; the introduction of time studies and of wage payment plans. Sometimes even sales policy and methods, financial policies and the set-up of the organization are held to be within the scope of the review necessary as the preliminary to establishing standard costs. The argument has been advanced that it is essential to reorganize the personnel to conform to proper functional lines and responsibilities, before it is of any use to attempt the installation of the accounting system.

Attempts to develop improvements in these various departments are laudable and may be beneficial, but they are not a part of the program for outlining the accounting plan. The risk involved when too broad a range of investigation is contemplated is, as experience teaches, that it may lead to a loss of all due sense of proportion and result in trying to reorganize the business to fit the accounting plan; to shift things about generally in the desire to obtain greater effectiveness before the means whereby effectiveness is to be measured—that is—the standard accounting system, are formulated.

It is not necessary to adopt time studies, to introduce wage payment plans, to improve processing methods and to re-aline personnel and in other ways to get all things standardized within a narrow radius of the ideal before standard costs can be established. For the introduction and use of basic standard costs, at any rate, none of these things need be done. It will be found improvements will naturally follow upon the adoption of basic standard costs, on account of the information disclosed, and that this information will be useful in directing the effort at improvement into the channels apt to be most productive.

Of course, it is desirable to have the standard costs founded upon time studies and carefully prepared standard practice instructions with specifications as to materials and processes, but this is not tantamount to holding that these are prerequisite to introduction of standard costs. When a business has been established for years, there often are available enough data of specifications and past performance to be usable, with some reclassification and judicious selection, for a beginning. Technical specifications for the manufacture of products and relating to the extent of machine possibilities, in particular, are almost always obtainable, because they are indispensable in shop operation. Information of this kind will suffice for building the initial standard costs, which can be perfected subsequently, in pace with the development of products and manufacturing methods. It is true that such standards may have faults in them; even the best of past performance may not always represent the possible accomplishment when standard practice instructions, new methods and regulation of production are provided. But the provision of these advantages is in the province of engineering, not of accounting. Indeed, such studies for the improvement of methods and policies in the conduct of all the various phases of business ac-

tivity are never ended, and the introduction of standard costs can not await their completion.

The point is that the establishment of the standard costs should be correctly regarded as the specific task of setting up formulas under conditions as they exist and not as the broad program for a general improvement, not to say reorganization, of the business. The standard costs are a means to the end: they are not the end itself.

Devising the accounting plan is mainly a problem in classification. The *Standard Dictionary* defines the word "class" as a "number of objects, facts or events having common accidental or essential properties". To classify, then, is to group things according to their relationship and to arrange the groups with an eye to relativity. In manufacturing operations, for instance, changes in material costs will affect, relatively, all the products into which a certain material enters. If the cost of cold rolled steel changes, it will affect in the same *degree* the material cost of all the products in which cold rolled steel is used. With labor, the qualities involved in effectiveness of performance will apply in much the same *degree* to all products going through the same operation. The same thing is true of burden. The problem in classification lies in determining the proper groups: those which are not too broad; those which do not comprise unrelated trends or cover too wide a range of "objects, facts or events", to maintain the community of their "accidental or essential properties".

Classification

The logical beginning in classification is to study the products which are made. If they are standardized or stock products, catalogues or stock lists will disclose the range and assortment of articles produced, which will be in various sizes and perhaps in different styles or patterns. Upon examination, it will be found that the products will fall into logical groups, according to nature or purpose or grade. These natural groups can be resolved into distinct classes. Some of the distinctions, especially those between classes, will extend into the manufacture of the products; although for the moment attention is directed to the sales classification or trade definition of

products, leaving the manufacturing classification for further consideration as another step.

If the products are not standardized or stock articles, but specialties or products made to order, a sales classification can be arranged similarly according to the nature of work done in the past. This classification will be more or less a pro-forma category, under which products are to be classed when orders for them are received.

Examples of the sales classification of stock products are given in Figs. 96 and 97, and of the sales classification of special products in Fig. 98.

The sales classification of products can not be finally determined until consideration has been given to requirements for the manufacturing classification, which may necessitate the making of some modifications in order that the two groupings may be consolidated. The manufacturing classification is usually a sub-division of the sales classification, and is absorbed into the latter.

Figure 96

SIMPLE SALES PRODUCT CLASSIFICATION
STOCK PRODUCTS
Furniture (chairs)

Chairs
- Windsor
- Bedroom
- Gum diners
- Oak diners
- Gum rockers
- Oak rockers
- K. D. white

Miscellaneous
- Wood parts
- Upholstering

FIGURE 97

COMPLEX SALES PRODUCT CLASSIFICATION STOCK PRODUCTS

Hardware

Hardware	*Classes*
Door checks	301-309
Builders' hardware	310-359
Farm hardware	360-369
Household hardware	370-379
Refrigerator hardware	380-389
Screen hardware	390-399
Shelf hardware	400-499
Stationery hardware	500-509
Toilet hardware	510-519
Hardware specialties	520-539
Screws	540-549
Tools	550-579
Bright wire goods	580-589
Special cylinders	600-609
Locks and lock sets	610-659
Padlocks	660-669
Ship hardware	670-679
Miscellaneous	680-699
Outside goods	700-701
Casket hardware	800-825

Door checks—(301-309 inclusive):

301 Door closer No. 205
302 Eclipse
303 Liquid (except No. 205 see No. 301)
304 Parts for door checks

Builders' hardware—(310-359 inclusive):

310 Case adjusters
311 Push bars
Kick plates
Push and pull plates (except No. 4303 and 4304)
Door pulls (from XX 5341 and grips)
312 Miscellaneous builders' hardware:
Door bells
Bell pulls
Bell turns

Umbrella and shaving brush holders
Wardrobe hooks
Hat pins
Pole brackets
313 Bolts, Cremorne for export
314 Bolts fire exit, except 4245 and 4248
315 Bolts, flush
316 Push plates No. 4043 x 4044 only (bought outside)
317 All cylinder locks for F. E. bolts (sold separately)
All latches other than cylinder for F. E. bolts sold separately.
318 Bolts, mortise door
319 Bolts, mortise extension
Bolts, Cremorne bolts (except No. 313)
Top and bottom surface
Mexican
321 Butts, Brass and bronze (except DF and DL finish) frictionless hinges No. 5851
322 Butts, iron
323 Transom catches
324 Sash centers
325 Transom chains
Transom eyes
326 Fasts, case
327 Fasts, chain door
auto door
328 Fasts, sash (except No. 451 and 542)
sash bolts 47 and 69
329 Fasts, cellar window and trimmings
330 Door handles
Door latches
331 Floor hinges
332 Door holders
334 Drawer knobs
336 Sash lifts and window pulls (includes 7841DC-7881DC-5841FX-5881FX)
337 Transom lifts
Skylight lifts
340 Sash and screen pulls
Sash pole, hangers and plates
Sash poles and sash cord irons
341 Screws and washers
342 Door stops

343 Sash pulleys
344 Fire exit bolts 4425, 8425
345 Sash fasts No. 451 and 452

Farm hardware—(360-369 inclusive):
360 Cow bells
361 Ox bells
Gate hooks No. 300
Carriage knobs
Cattle leaders
Ox bow pins
Bull snaps
363 Bull rings
365 Scale beams

Household hardware—(370-379 inclusive):
370 Food choppers
371 Tack claws
Garden forks
Hammers
374 Can openers
375 Ice awls
376 Parts for food choppers

Refrigerator hardware—(380-389 inclusive):
380 Refrigerator catches
Ice box fasts
Refrigerator hinges
383 Meat and corned beef hooks

Screen hardware—(390-399 inclusive):
390 Door and window screen brackets
Screen springs
391 Screen door catches
392 Screen door checks (no slam, etc.)
393 Screen door sets
Screen door spring hinges
394 Screen door latches

Shelf hardware—(400-499 inclusive):
400 Barrel bolts
401 Bottom bolts
Chain bolts
Foot bolts

402 Cupboard bolts
Flat bolts
Square bolts
Neck and Spring bolts
403 Eye bolts and swing bolts
404 Window spring bolts
Window spring belt sockets
Window springs
405 Corner braces
Corner irons
Mending plate—corner plates
T. plates
406 Buttons
407 Steel butts
408 Cupboard turns Nos. 5144 and 5244
409 Cupboard latches (G57-G59)
Cupboard turns (except Nos. 5144 and 5244)
410 Cupboard catches
Elbow catches
Flush catches
French window catches
411 Jack chain
414 Chest and tub handles
Drawer and lift handles
Flush trap door rings
Flush chest handles
416 H. R. Brackets
H. R. Plates
H. R. screws
418 Hasps and staples
Hooks and staples
Staples on plates
Staples (9-8-10-501)
420 Wrought plate and hook hinges
421 Toilet hooks
Towel hooks
C & H hooks (cast)
Ceiling hooks (cast)
Hotel hooks
Wrought C & H hooks
422 Awning hooks
Leader and pipe hooks
Sign hooks

423 Belt hooks
424 Ceiling hooks (wire)
C & H hooks (wire)
426 Clothes line hooks
Display hooks
Fire pail hooks
Harness hooks
429 Hammock hooks
430 Hooks and eyes
431 S. hooks
Open links and D links
432 Screw hooks (410 and 212)
433 Desk hooks and telegraph
Brush or duster hooks
Drive hooks
Kitchen hooks
Pitcher hooks
435 Picture knobs
Sash knobs
Shutter knobs
Curtain pins
441 Pulleys and rope guides
442 Door pulls (light) 405-407 to and including XX-885
443 Drawer pulls
444 Barn door rail (except 681-691-791)
Sheaves
Sash rail
Sliding door rail
445 Shelf rests
446 Flush rings
447 Barn door rail 681-691-791 (bought outside)
448 Wrought steel trap door rings and hitching rings
449 Sash rollers
454 Miscellaneous shutter, gates and blind hardware:
Blind fasts
Blind hinges
Gate hinges
Gate latches
Shutter bars
Shutter rings
Shutter screws
Turnbuckles
Stubs and plates

456 Door springs
457 Staples (except No. 57)
459 Well wheels and hooks
470 Miscellaneous shelf hardware:
Line cleats
Box corners
G. C. hangers and stays
B. C. rollers
Hinge hasps or padlocks hinges
Chandelier hooks
Label plates
Looking glass plates and screws
Scuttle fasts
Scuttle hinges

Stationery hardware—(500-509 inclusive):
500 Twine boxes
Paper clips
Paper files
File hooks

Toilet hardware—(510-519 inclusive):
510 Toilet door belts
Toilet door latches
Bumpers and strikes for toilet door
511 Spring hinges for toilet doors

Hardware specialties—(520-539 inclusive):
522 Figures and letters
523 Cake fillers
524 Molasses gates
525 Pastry jaggers
526 Door knockers
527 Letter box plates
Door and name plates
529 Casters
530 Miscellaneous hardware specialties:
tobacco cutters
sausage stuffers
531 Foot scrapers
532 Stool and chair screws
533 Barrel swings
534 Table leaf supports

Screws—(540-549 inclusive):
- 540 Bright iron
- 541 Japanned and galvanized
- 542 Brass and bronze

Tools—(550-579 inclusive):
- 550 Nail claws (garden hooks) and tongs
- 551 Screw drivers
- 552 Bench hooks
- 553 Box hooks
- 554 Pincers, tongs, etc.
  - Hoof nippers
  - Carpenter pincers
  - Horse shoeing pincers
  - Blacksmiths' tongs
- 555 Bench plants Nos. 8043-8243 inc. Nos. 770-792 inc. Nos. 704-742 inc. Nos. 770G-792G inc. Nos. 704G-742G inc.
- 556 Bench screws
- 557 Saw screws
- 558 Saw sets
- 560 Plumb bobs
- 561 Clamps and door clamps (except carriage maker's clamps)
- 562 Miscellaneous tools:
  - Awls
  - Chisels
  - Clamp heads
  - S. G. fixtures
  - Brad awl handles
  - File handles
- 563 Bench vises
- 564 Saw vises
- 565 24″ squares other than take down (except squares Nos. 41, 57, 69)
- 566 Take down squares 500 (all finishes)
- 567 Squares less than 24″ Nos. 20, 22-40 (all finishes)
- 568 Squares No. 41
- 569 Block planes:
  - 401-408 inc.
  - 602-618 inc.
  - 603-607-456-457-6031-7031-6061-613-6-4-4022-6025-6026-6027
- 570 Miscellaneous planes
- 571 Carriage maker's clamps

Bright wire goods—(580-589 inclusive):
- 580 Awning eyes, Cup hooks, Screw hooks, Screw eyes, Cornice hooks, Storm window eyes } steel
- 581 Cup hooks (brass No. 18)
  Screw hooks (brass No. 214)
- 582 Gate hooks and eyes, Screw hooks, Screw eyes } brass
- 583 All finishes in No. 802 and 822 other than steel or brass
- 584 Gate hooks and eyes

Special cylinders—(600-609 inclusive):
- 600 Automobile and special cylinders
- 601 Locker locks except 5061
- 602 Cabinet locks
- 603 Auto cyl. parts (keys, etc.)

Locks and lock sets—(610-659 inclusive):
- 610 Rim locks except 3122, 3123 night latches and ship locks
- 611 Inside locks and lock sets (steel or iron fronts and steel or pottery trim (except broad bevel steel sets 442CX and 542CX)
- 612 Broad bevel steel sets 442CX and 542CX
- 613 Rim locks and sets 3122-3123
- 614 Inside locks and lock sets (brass or bronze fronts and brass or bronze trim, all except 513)
- 615 Inside locks and lock sets (brass or bronze fronts with glass knobs)
- 616 Rim lock sets except 3122-3123
- 617 French window locks and sets with steel trim (all designs)
- 618 French window locks and sets with brass and bronze trim (all designs)
- 619 Bit key front door locks and sets with steel trim (except steel broad bevel bit key front door sets 8214XC and 8414 XC)
- 620 Bit key front door locks and sets with brass or bronze trim (all designs)
- 621 Bit key store door handle locks and sets, steel trim
- 622 Bit key store door handle locks and sets, brass and bronze trim

623 All other mortise bit key locks and sets
624 Cylinder front door and vestibule locks and sets
625 Broad bevel steel bit key front door sets 8214XC and 8414XC
626 Cylinder door handle locks and sets
627 Night latches flat and bit key No. 7224 only
628 Cylinder mortise dead locks and sets
629 Cylinder night latch 7824
630 All other cylinder locks and sets (except class 71-233-234, includes locker lock 5061)
632 Night latches, cylinder (except No. 7824)
633 Cylinder rim draw back and dead locks
634 Mortise cylinders
635 Rim cylinders
636 Bath room locks and sets
637 Escutcheons, brass or bronze
638 Escutcheons, iron and steel
639 Knobs, wrought brass or bronze, including Nos. 2261-2262-2263-2265-2266-2257 and 2461
640 Knobs, other brass and bronze
641 Knobs, glass
642 Knobs, iron or steel
643 Knobs, pottery
644 Roses, brass or bronze
645 Roses, iron or steel
646 Thumb knobs
647 Miscellaneous lock trim, keys strikes, etc.
648 A. B. handles (iron and steel)
649 A. B. handles (brass and bronze)
650 Push buttons
651 Hotel corridor door locks (bit key and cylinder, including Nos. 1961-2061-2062-2063-2064-2068-2069-2170-2171-2172-2174-2175-2216-2217-2219-2220-2229-2230-2233-2235-2237-2238-2239-2515-2516-2517-2518-2519-2520-2523-2525-2527-2529-2530-2533-2542 HM).
652 Key in knob locks 5089-5489-6189-5669-6569—all in DE-CX-JL-KM designs and all both regular and reverse bevel 6469 DE—JL and KM in brass bronze and EE.

Padlocks—(660-669 inclusive):
660 Padlocks, cylinder
661 Padlocks, sub-cylinder
662 Padlocks, flat and bit key (except No. 207)
664 Padlocks, flat and bit key No. 207 only (bought outside)

Ship hardware—(670-679 inclusive):
670 Flush cup handles
Knobs and drop handles
Knobs and ring handles
671 Brass and bronze rim locks and sets
672 Brass and bronze butts in CF and CE finishes
672 Ship hinges (marine catalogue)
673 Cabin door hooks

Miscellaneous—(680-699 inclusive):
680 Empty boxes, oil paper, strips, etc.
681 Miscellaneous repairs on planes, padlocks, locks, etc.
682 Miscellaneous parts for bolts, cake fillers, bench screws
684 Wooden cases
685 Samples

Outside goods (700-709 inclusive):
700 Foreign goods
701 Hinge nails
Steel washers
Brass butts 4252-4352
T hinges—light
heavy
extra heavy
Staples No. 57 only
Shelf brackets
709 Other outside goods

Casket hardware—(800-825 inclusive):
800 Casket handles
801 Extension handles
802 Bail handles
803 Britannia and case metal plates, struck-up plates except (33D) our make, box plates and head plates of our make (33E)
804 Ornaments
805 Cap lifts
806 Thumb screws (and escutcheons) and urns and plates
807 Outside box corners
808 Outside box handles used only in casket hardware
809 Outside box handles (chest handles) used in general hardware
810 Miscellaneous hardware made by us sold also in general hardware

811 Miscellaneous hardware made by us sold only in casket hardware
812 Struck-up plates, studs, ornaments and moulding tips bought outside, box plates and head plates bought outside
813 Miscellaneous hardware, bought outside
814 Miscellaneous casket handle parts
817 Outside box corners (600-700)
818 Box corner trimmings
820 Casket handle trimmings
822 Bail handle trimmings
823 Head plates (31D and 31E)

Obsolete product classes:

1021 Locks, lock trim and padlocks
1921 1121 Other goods
1221 Casket hardware

1022 Locks, lock trim and padlocks
1922 1122 Other goods
1222 Casket hardware

1023 Locks, lock trim and padlocks
1923 1123 Other goods
1223 Casket hardware

FIGURE 98

SALES PRODUCT CLASSIFICATION
Specialty products (printing industry)

01 Farmers' Mail Order Co. Catalogues
02 Farmers' Mail Order Co. Miscellaneous
03 Mail order catalogues (other than Farmers' Mail Order Co.)
04 Mail order miscellaneous (other than Farmers' Mail Order Co.)
05 Camera lights
06 Magazines (other than camera)
07 Color work (billed separately as such)
08 General printing

In surveying the manufacturing situation for the purpose of preparing the manufacturing classification, the first step is to examine the plant and study the operating processes. When a good idea has been obtained of the plant layout, the flow of materials and products through the operating departments and processes must be traced and thoroughly understood. It is usually helpful to prepare a "process flow chart," or a series of charts, portraying graphically the manufacturing processes from the time when materials enter into work until the finished products issue ready for shipment. An example of such a process flow chart, in a comparatively simple case, is given in the Appendix, chart IV.

As the result of this study, it will be found that the manufacturing classification of products again will fall into natural groups to some extent, and possibly distinct classes following those in the sales classification, although these classes may cross; that is to say, there may be interchangeable or transformable products. It may also be found that the plant can be divided into definite sections, according to the natural product grouping or classes.

When the flow of processes has been visualized, the next step in the analysis is to ascertain what broad processing characteristics or major plant divisions there are. It may be found that there are two main divisions in the manufacturing activity, which, although they are related, are separate undertakings. Examples of such divisions are yarn making and knitting, manufacturing and assembling, spinning and weaving.

Clearly, it will be desirable to keep separate, in the accounting plan, operating data regarding these divisions. The variations in them will be different. The manufacturing facilities may be in the proper proportions for balanced production, but probably they will not be. At any rate, the fluctuations and the degree of capacity used in the two divisions will differ. Perhaps some or all of the products emanating from the first division, which are carried through further processing in the second, are salable in the partly processed form; that is to say, as they issue from the first division. And, conversely, outside material purchases of products similar to those made in the first division may occur, for use in the subsequent operations of the second. For these reasons the need of such a major separation is plain.

There may be another prominent characteristic in the preparatory operations, that is, some process or sequence of processes through

which materials pass to a certain point, at which they may be separated for further processing, passing into the product classification for which they are destined. Examples of such preparatory operations are to be found in foundries, in making castings later to be machined and used in making numerous products; in mixing operations, as the result of which ingredients are merged and are delivered in some composite form for further treatment; in the case of linoleum, in which there are series of such preparatory operations, first the oxidation of the linseed oil, next the grinding of cork, then the combination of these into the basic composite, which may be in different grades, and ultimately the addition of colors and calendering in various grades and patterns, which determine the final product classification. A major separation will be necessary in the accounting plan for such preparatory processes, not only because they will be subject to variations peculiar to themselves, but also because the ingredients are merged and the products for which they are intended may not be known at the outset.

Again, there may be supplementary operations in which diverse products, having passed through the primary manufacturing operations, are brought together in combinations for some treatment, such as dyeing or plating, after which they will again be separated into their original classifications. In such cases, it probably will not be desirable, or it may not be possible, to keep separate accounts by the original product classes of such treatment in combination. Provision, therefore, must be made for an appropriate grouping for such supplementary operations in outlining the accounting plan.

After these major characteristics have been determined and a rough outline of the manufacturing classification has been made, its sub-division into departmental processes and operations must be worked out. The physical departmental lay-out will be a guide, for this will often follow the processing sequence and the lines of responsibility. But the physical departments will not necessarily indicate the most desirable account grouping for the work-in-process accounts. If a department is large and comprises a variety of operations, or too many diverse products pass through it, for the variations occurring in the department as a whole to be suitably applicable to all the products, the necessity for an accounting sub-division

will be apparent. On the other hand, a number of small consecutive departments, separate physically, may be consolidated in the work-in-process accounting plan.

Two things must be borne in mind, in this detailed study which shall finally determine the classification of work-in-process accounts, namely: (1) that the cost ratios, actual to standard, for materials, labor and burden developed in each account will be applied for costing purposes to all products comprised in the class, and (2) that it will be necessary to be able to identify and obtain production reports for each classification. Therefore, the feasibility of obtaining the information will have a bearing in deciding the grouping.

Work-in-Process Accounts

The choice as to the grouping of the work-in-process accounts lies among four arrangements, namely:

A—Material, labor and burden by product class
B—Material, labor and burden by department
C—Material by material class
Labor and burden by product class
D—Material by material class
Labor and burden by department.

In some cases, one of these arrangements can be used throughout, but often two or more of them will be used, because a single grouping will not fit all the operations equally well.

When plan A or plan B is used, it will be found desirable to keep the figures for material, labor and burden separate in a columnar arrangement; although frequently it is possible to combine labor and burden.

The manufacturing product classification must be prescribed with care to avoid bringing into one group products which are too dissimilar to permit obtaining reasonably correct results from the application of a single cost ratio. This will apply especially to material under plans A and B. It would not do, for example, to place in one product class articles made of grey iron, wood, steel and rubber, because the application of a single cost ratio to standard would not give the correct cost of production for the different articles, unless

it happened that the articles were all closely similar or the same article was made in different sizes with the proportion of material content uniform.

The classification must be arranged so that the minimum probability of error will be encountered in using the cost ratios. It will be evident that the effect in costing production in groups of relative items is to spread the variations in each group over the items in it. The various items, of course, are taken into account at the differential of their respective standards, but the variations therefrom for the group as a whole are applied to all the items and are carried in this way through the accounts into the final cost of production. It is possible to arrange the classification so that the probable error in the total cost of any item is small in percentage.

The question is sometimes raised how it is possible under this procedure to find the actual cost of a single product in a group, which, to emphasize the question, may be assumed to have run considerably out of line. Under this method, the variation would be merged in the cost of all the products. The answer is that it is not possible to find the actual cost of a single product under this method or under any method. The actual cost of a single product can not be found unless a single product only is made. When numerous articles are manufactured, it is a practical impossibility to isolate the cost of any one. That is to say, the actual cost of a single product is a theoretical calculation. It must be remembered that the activities in a factory making numerous products are all inter-related, in some respects nearly and in others remotely, so that a calculation of actual cost, so far as it concerns an individual product, will include many forced applications and arbitrary assumptions. Moreover, the "actual cost" of an individual product is information less significant than the variations arising in a group of related products, because the manufacturer is engaged in making the group of products, not in making a single product. The object is to manufacture the group effectively and to sell the product at a profit on the whole.

If a single article in the group in which the assumed hidden variation falls is being manufactured in sufficient volume to cause the variation involved to be substantial, the effect of it will be noticeable in the group result. For instance, if in the manufacture of a class of

gadgets, a heavy spoilage loss is unavoidable on the gadgets smallest in size, no serious error arises, because the loss on the small gadgets is merged in the cost of all gadgets in the product class, so long as the number of small gadgets manufactured is in proper proportion to the total production for the class. If it happens that under the production schedule a disproportionately large number of small gadgets is made or suddenly there is a big increase in the demand for small gadgets, the influence of the relatively increased spoilage loss on the group will be immediately apparent in the group ratio. If such an influence is not apparent, the variation is insignificant. Moreover, it must be remembered that knowledge as to what is happening is soon gained through the analysis of spoilage variations under the procedure described in previous chapters.

Should it be that the standard cost of a single article supposed in the question were incorrect, this would be a different matter; it would be necessary to correct the standard. Even in this event, however, if the error is important, the group ratio eventually will reveal it, because the cost ratio will indicate variations, whether they be due to actual costs which are too high or standard costs which are too low.

Plan B can seldom be used throughout for an entire factory, except in simple cases. It is more apt to be used for certain departments, especially such as those previously mentioned, which are occupied in preparatory or supplementary operations.

Plans C and D on the whole are the more satisfactory. Under them materials are grouped by material classes and labor and burden by product classes or departments. However, plan C has the disadvantage that the standard cost of production must be obtained by operations, in order to avoid the error which might be caused by fluctuations in the inventory of work-in-process; also, the accounts comprise all work-in-process, so that for a large factory probably they would have to be sub-divided by sections or departments.

Plan D is satisfactory especially in cases when the departments according to which labor and burden are grouped are practically identical with major operations in the processing chain.

Attention must be given to the flow of interchangeable products and to opportunities which may exist for products to criss-cross be-

tween product classes through their being transformable from one product into another. The flow chart of manufacturing processes should clearly show any such possibilities. Care must be exercised in arranging the account grouping so that it will not be necessary when the procedure is in force to obtain an excessive number of production reports on intermediate transfers. It may be advisable in such cases to accumulate the labor and burden costs by product classes, without attempting to reflect in the accounts the actual transfers in products as they progress toward completion, and then to compile the costs of the eventual products by assembling appropriate labor and burden costs from the separately accumulated figures in the product class accounts.

Obviously it is necessary that the standard cost of production shall be commensurate with the actual cost in the group accounts, allowing for work-in-process fluctuations. The direct way of accomplishing this is to obtain the standard cost of production by individual operations, which automatically reconciles the total standard cost of production in each group with any increase or decrease in work remaining in process. Often there are opportunities for simplifying this calculation by omitting the standard costing of intermediate operations and computing standard cost of production on the basis of finished or partly finished products delivered at certain points. When this is done, it must be ascertained whether the work-in-process inventories are normally constant or vary considerably from one period to another. Sometimes the flow of work or the nature of the processes is such that the balance of work-in-process is fairly uniform, and in these convenient circumstances it is possible to set the standard cost of delivered production against the actual group cost for the period. More often the conditions will not be so favorable for the purpose, but it may be easier to obtain a work-in-process inventory by count at the end of each period, with which to adjust the total standard cost of delivered production to allow for a fluctuation in incomplete work, than it would be to price all operations at standard costs. In such a case that is the obvious choice as to mode of procedure. In rare cases it will be practicable to clean up all work in progress at the end of the period and, when this can be done, there is the added advantage of finishing the work in hand.

It is a mistake to attach too much weight to the maintenance of figures upon work-in-process by departments, in outlining the work-in-process accounting plan. As stated before, a departmental classification may be too broad to produce group ratios that are suitable when a variety of products passes through the departments, and if a departmental account classification is adopted in order to have the account balances represent departmental work-in-process inventories, it must be with understanding that, in order to overcome the risk of incorrect ratios, it may be necessary to sub-divide the accounts into production centers or product classes. But there is no great advantage in having at hand figures as to the cost of work-in-process by departments, because almost the only use for the information is to observe the status and the trend of the volume of such work, which can be done as readily by other means. This plan, therefore, should be abandoned when another grouping for the work-in-process accounts is better than the departmental one.

In the record of production, the factor of spoiled work and scrap must be remembered. Waste of this kind should be taken into account by deducting appropriately, in the work-in-process group accounts, the reclaim value of the spoilage and scrap produced. The manner of doing this depends upon the plan adopted for material work-in-process accounts. If it is feasible to set the standard material cost of net good production (including any fluctuation in work-in-process) against the actual cost of material drawn, the deduction for scrap and spoiled work need be made under actual costs only, inasmuch as the standard cost of production is net; i.e., the deduction at standard is already included. But if it is the procedure to charge work-in-process accounts at the actual and standard cost of material drawn and to credit them for net material in products finished, the deductions must be made from the charges at both actual and standard costs, taking reclaim value from "actual" and full standard material cost from "standard". This has the effect of reducing the standard charges more than the actual charges, thus increasing the cost ratio sufficiently to cover the losses, and of bringing the standard costs on the one side to the same basis as on the other. Or, if the basic standard costs are set up to derive net material after including allowance for scrap at basic standard scrap values,

the procedure will require deductions from work-in-process charges at reclaim value under "actual" and at standard scrap values for scrap, with full standard material cost for spoiled work under "standard". In the last two cases, deviations in yield must be disclosed by work-in-process inventory verifications at proper periods.

It should be observed in the study of the manufacturing operations whether "set-up" is an important factor or not. Frequently the operations of setting up or making ready machinery and facilities for production involve a substantial part of manufacturing cost. It will follow, therefore, that if the quantity of products to be made is less than an economical lot, when the necessary preparation is taken into consideration, a grave variation in costs may ensue. It will be evident that if it costs as much to make ready to run as it does to run a given number of articles, the running costs varying with the number, and only half the quantity is manufactured, the cost of the lot is one and one-half times what it would be if the given number were run. Hence set-up or make-ready may be an important factor and, if so, it will be desirable to treat it as a separate item of production. In other words, the basic standard costs will include separate calculations for the making-ready operations. In manufacture, such operations will be reported as production and priced at standard cost as if "make-ready" were a separate product. It will then be possible to show, not only the effectiveness with which preparatory operations are conducted, but also the influence upon costs of deviations from economical manufacturing lots.

The features which have been reviewed are the more prominent in the survey of manufacturing operations, to be considered in determining the manufacturing product classes and the work-in-process accounts. Examples of a manufacturing classification paralleling the sales product classification previously illustrated (Figs. 96 and 98) are given for stock products in Fig. 99, and for specialty products in Fig. 100.

Finished Stock Accounts

When finished stock accounts are carried, they will ordinarily follow the product sales classification. Finished production delivered from work-in-process will be credited to the work-in-process

accounts in their grouping and transferred to finished stock accounts in the sales grouping. Material, labor and burden costs frequently will be merged and carried in the finished stock accounts in total only; although it is sometimes desirable to carry material separately in the finished stock accounts, especially if there are some prominent basic materials which are subject to speculative market fluctuations. The circumstances in each case must determine what is required.

In some cases of stock products sold with a rapid turnover or specialty products made to order for which very little finished stock is kept on hand, shipments practically being made from work-in-process, it may not be necessary to carry separate finished stock accounts. When they can be avoided, it is a gain in the direction of simplicity and economy.

Figure 99

SIMPLE MANUFACTURING PRODUCT CLASSIFICATION
STOCK PRODUCTS

Furniture (chairs)

Work in process

Material
- Lumber (by kinds)
- Maple bows
- Veneers
- Cane and spline
- Finishing material
- Upholstering material
- Packing material

Labor and burden
- Period
- Box seat
- Rocker
- Oak finish
- Walnut finish
- Upholstering

Departments

Direct labor
- Dimension
- Veneer
- Machine
- Cabinet
- Finishing (including rubbing)
- Upholstering
- Packing

Indirect labor
- Making (dimension, veneer, machine and cabinet)
- Finishing (finishing, rubbing, upholstering and packing)

FIGURE 100

MANUFACTURING PRODUCT CLASSIFICATION

Specialty products (printing industry)

01–39 Catalogues and flyers:
- 01 Farmers' mail order catalogues
- 02 Bargain Stores Co. catalogues
- 03 State Wholesale Co. catalogues
- 04 Better Seeds Corp. catalogue
- 08 Miscellaneous large catalogues (96 pages or over)
- 09 Miscellaneous small catalogues (less than 96 pages)
- 15 Mail order flyers—one color
- 16 Mail order flyers—two or more colors
- 17 Farmers' Mail Order Co. flyers
- etc.

40–79 Magazines:
- 40 Camera lights
- 41 High School Fun
- 42 Browns Corners
- 43 Hilarity
- 44 Failure
- 50 Sheep Bazaar
- 51 Indoor Sports
- 59 Apparel
- etc.

80–99 General printing:
- 80 Color printing (not otherwise specified)
- 81 Unbound forms
- 82 Folders and price lists
- 83 Broadsides
- 84 Booklets (one color)
- 85 Booklets (two or more colors)
- 86 Job press work
- etc.

Cost of sales is obtained by pricing shipments at basic standard costs and converting the total in each product class to the level of actual costs, by applying the cost ratios in the finished stock accounts. Usually it will suffice to use the preceding month's cost ratio, that is, the ratio on the preceding month's opening inventory plus receipts. At other times, it may be necessary to use a ratio for the current period; that is to say, the merged ratio as to stock on hand at the beginning of the period and products received into stock during the period. In this event, the conversion of actual cost of sales must await the completion of the current month's cost calculations. In the other event, when the preceding month's finished stock ratio can be used, the calculation of the cost of sales and the preparation of the profit-and-loss account can be completed earlier.

The work of extending shipments at basic standard cost of sales ordinarily presents no great difficulty. It is necessary to provide means for pricing the articles billed at the basic standard costs and for accumulating group totals to which the appropriate group ratios can be applied to convert the basic standard costs to the level of actual costs. Sometimes, especially in stock industries, the number and variety of products is so great and the number of shipments and invoices is so large that to price and extend each item billed would be an enormous task. Then it becomes imperative to find another way for computing cost of sales to avoid the detailed calculation. Fortunately in such cases the articles are usually completely catalogued with list prices and the terms of sale are "list" less discounts. Also, the very variety and number of the products furnishes an opportunity to employ the law of averages. A code can be prepared containing 100 brackets covering all the possible relations of basic

standard costs to list prices, from one per cent. of list to one hundred per cent. of list. Each bracket applies to a range of ratios; a mean ratio is designated, which is to be used for all articles with ratios of cost to list in that range. An example of such a ratio code is given in Fig. 101:

FIGURE 101

RATIO CODE AND SYMBOLS

Ratio symbols	*Code no.*	*Ratio cost to list*	*Range*	
			Low	*High*
A9	89	2.50	1.000	3.499
A8	88	4.00	3.500	4.499
A7	87	5.00	4.500	5.124
A6	86	5.25	5.125	5.374
A5	85	5.50	5.375	5.624
A4	84	5.75	5.625	5.874
A3	83	6.00	5.875	6.124
A2	82	6.25	6.125	6.374
A1	81	6.50	6.375	6.624
A0	80	6.75	6.625	6.874
B9	79	7.00	6.875	7.124
B8	78	7.25	7.125	7.374
B7	77	7.50	7.375	7.624
B6	76	7.75	7.625	7.874
B5	75	8.00	7.875	8.124
B4	74	8.25	8.125	8.374
B3	73	8.50	8.375	8.624
B2	72	8.75	8.625	8.874
B1	71	9.00	8.875	9.124
B0	70	9.25	9.125	9.374
C9	69	9.50	9.375	9.624
C8	68	9.75	9.625	9.749
C7	67	10.00	9.750	10.249
C6	66	10.50	10.250	10.749
C5	65	11.00	10.750	11.249
C4	64	11.50	11.250	11.749
C3	63	12.00	11.750	12.249
C2	62	12.50	12.250	12.749
C1	61	13.00	12.750	13.249

Ratio symbols	*Code no.*	*Ratio cost to list*	*Range*	
			Low	*High*
C0	60	13.50	13.250	13.749
D9	59	14.00	13.750	14.249
D8	58	14.50	14.250	14.749
D7	57	15.00	14.750	15.249
D6	56	15.50	15.250	15.749
D5	55	16.00	15.750	16.249
D4	54	16.50	16.250	16.749
D3	53	17.00	16.750	17.249
D2	52	17.50	17.250	17.749
D1	51	18.00	17.750	18.249
D0	50	18.50	18.250	18.749
E9	49	19.00	18.750	19.249
E8	48	19.50	19.250	19.749
E7	47	20.00	19.750	20.499
E6	46	21.00	20.500	21.499
E5	45	22.00	21.500	22.499
E4	44	23.00	22.500	23.499
E3	43	24.00	23.500	24.499
E2	42	25.00	24.500	25.499
E1	41	26.00	25.500	26.499
E0	40	27.00	26.500	27.499
F9	39	28.00	27.500	28.499
F8	38	29.00	28.500	29.499
F7	37	30.00	29.500	30.499
F6	36	31.00	30.500	31.499
F5	35	32.00	31.500	32.499
F4	34	33.00	32.500	33.499
F3	33	34.00	33.500	34.499
F2	32	35.00	34.500	35.499
F1	31	36.00	35.500	36.499
F0	30	37.00	36.500	37.499
G9	29	38.00	37.500	38.499
G8	28	39.00	38.500	39.499
G7	27	40.00	39.500	40.999
G6	26	42.00	41.000	42.999
G5	25	44.00	43.000	44.999
G4	24	46.00	45.000	46.999
G3	23	48.00	47.000	48.999
G2	22	50.00	49.000	50.999

Ratio symbols	*Code no.*	*Ratio cost to list*	*Range* *Low*	*High*
G1	21	52.00	51.000	52.999
G0	20	54.00	53.000	54.999
H9	19	56.00	55.000	56.999
H8	18	58.00	57.000	58.999
H7	17	61.00	59.000	61.499
H6	16	63.00	61.500	64.499
H5	15	66.00	64.500	67.499
H4	14	69.00	67.500	70.499
H3	13	72.00	70.500	73.999
H2	12	76.00	74.000	77.999
H1	11	80.00	78.000	81.999
H0	10	84.00	82.000	85.999
J9	09	90.00	86.000	91.999
J8	08	94.00	92.000	95.999
J7	07	98.00	96.000	99.999
J1	01	basic standard cost	100%	
Z0	90	1.07		
Z1	91	1.10		
Z2	92	1.13		
Z3	93	1.15		
Z4	94	1.20		
Z5	95	1.25		
Z6	96	1.30		
Z7	97	1.45		
Z8	98	1.50		
Z9	99	—		

The range of the ratios in each bracket is established so that the maximum possible error in any instance is not greater than 2½%, and in the brackets in which the largest volume of products will fall the maximum possible error is as low as ½%. A neutral symbol is allotted to each bracket. These symbols are then embodied in the standard description, catalogue numbers or stock symbols for all products and are typed on invoices when shipments are billed. Tabulating cards are cut from copies of invoices, and at the end of the month or other accounting period the accumulated cards for each product class are sorted according to the ratio code

symbols. Then the mean ratio is applied to the total of shipments at "list" in each bracket, to obtain basic standard cost of sales.

The law of averages will greatly reduce the maximum possible error through this method of calculation and will offset the over-costing as to products having ratios of cost to list above the mean against the under-costing of products having ratios of cost to list below the mean, and in the net it will confine the maximum probable error to half of one per cent. or less in the aggregate. In fact, tests comparing the results between ratio code calculations and straightforward detailed pricing of items indicates that the ratio calculations tend, if anything, to be more accurate. The clerical work involved is obviously very much less.

The question arises with regard to finished stock accounts at the end of the fiscal period: What is to be done with under- or over-absorbed burden? If there is unabsorbed burden, the actual costs in the finished stock accounts are under-stated, because a part of the cost of production (in the broad sense) has been excluded. If the accounts indicate, on the other hand, that burden has been over-absorbed in the cost of production, the inventory represented in the finished stock accounts is over-stated, because disbursements and accruals chargeable to manufacturing operations on the whole were less than the level at which they stand in the accounts.

Usually unabsorbed burden will be charged off to profit-and-loss, although the effect of this, as it relates to closing inventories, must be taken into account for income-tax purposes, following the principle of valuing inventories at cost or market, whichever is the lower. The question, in the case of unabsorbed burden, is almost self-answering, the conservative policy being to take the loss at once. But if burden has been over-absorbed, sound accounting principle requires adjustment to the finished stock accounts to eliminate over-statement. The preferable manner of doing this is to set up suitable inventory reserve accounts, containing amounts in reduction of book inventories sufficient to eliminate over-absorbed burden. The entire amount of the latter will not be set up in the reserve accounts, because, obviously, a portion of it applies to cost of sales in the period. It is necessary to calculate the relation between over-absorbed burden and cost of production during the period and to

apply the former ratably to cost of sales and cost of stock remaining on hand. The allocation will vary according to the circumstances. Allotment by percentages is usually sufficiently accurate for the purpose.

In the ensuing fiscal period, the amounts which have been set up in the inventory reserve accounts are absorbed as products are shipped.

Physical inventories are advisable at stated intervals or by continuous count. In case a substantial difference is disclosed between the physical and the book values at basic standard costs, the necessary adjustment must be made with discretion. If the difference is a shortage, it may be due to the movement of products without due credit—that is, an actual shortage. But the difference may be caused by incorrect entries in the accounts. If it is an overage, it is probable that too little standard cost has been charged into the accounts or too much has been credited for cost of goods sold. In either case, to the extent to which the standard cost entries appear to be incorrect, the cost ratios based on them are incorrect, and the adjustment must include the revision of the cost ratios and actual costs accordingly.

For income-tax purposes, the regulations require the inventory to be reflected at cost or market, whichever is the lower. Under the basic standard cost method, the finished stock accounts are carried at actual costs, subject to consideration of the foregoing adjustments. Under the ideal standard plan, when the finished stock accounts are carried at standard costs, it will be necessary to adjust them to the proper basis for tax purposes.

Departmental Expense Accounts

In addition to the work-in-process accounts and finished stock accounts, the outlining of the general plan requires the provision of suitable departmental expense accounts. These should follow the lines of responsibility and parallel the arrangement of the burden budget. They are provided to record on one side the details of actual expenses incurred and on the other the amounts which have been absorbed in cost of production. The difference between actual

FIGURE 102

EXAMPLE COMPARING THE RESULTS OF DISTRIBUTING FIXED EXPENSES BETWEEN OPERATING DEPARTMENTS AND NOT DISTRIBUTING THEM BUT SPLITTING ABSORBED BURDEN BETWEEN CONTROLLABLE AND FIXED EXPENSES

Budget

Department I

	Amount	% to Total
Controllable expenses	$ 27,500	55%
Fixed expenses:		
Insurance	2,500	5
Taxes	2,500	5
Depreciation	5,000	10
General plant	12,500	25
Total expenses	$ 50,000	100%

Department II

	Amount	% to Total
Controllable expenses	$ 45,000	45%
Fixed expenses:		
Insurance	5,000	5
Taxes	10,000	10
Depreciation	20,000	20
General plant	20,000	20
Total expenses	$100,000	100%

Loss

Distribution method

Department I

Actual expenses			
Controllable	$25,000	Absorbed	$46,000
Fixed expenses:		Unabsorbed burden	*1,150*
Insurance	2,400	Spending variation	2,850
Taxes	2,750	Operating variation	*4,000*
Depreciation	5,000		
General plant	12,000		
Total expenses	$47,150		

Department II

Actual expenses			
Controllable	$40,000	Absorbed	$80,000
Fixed expenses:		Unabsorbed burden	*14,800*
Insurance	4,800	Spending variation	5,200
Taxes	11,000	Operating variation	*20,000*
Depreciation	20,000		
General plant	19,000		
Total expenses	$94,800		

Summary

Spending variation	8,050
Operating variation	*24,000*
Unabsorbed burden	*15,950*

Split credit method

Actual expenses	*Absorbed burden*	*Unabsorbed burden*	*Spending variation*	*Operating variation*
	Department I—controllable			
25,000	25,300	300	2,500	*2,200*
	Department II—controllable			
40,000	36,000	*4,000*	5,000	*9,000*
	Fixed expenses			
	Insurance			
7,200	2,300 D. I 4,000 D. II 6,300	*900*	300	*1,200*
	Taxes			
13,750	2,300 D. I 8,000 D. II 10,300	*3,450*	*1,250*	*2,200*
	Depreciation			
25,000	4,600 D. I 16,000 D. II 20,600	*4,400*	—	*4,400*
	General plant			
31,000	11,500 D. I 16,000 D. II 27,500	*3,500*	1,500	*5,000*
	Total			
141,950	126,000	*15,950*	8,050	*24,000*

Credits are split on the basis of the budgeted percentages.

charges and the amounts absorbed is over-absorbed or unabsorbed burden.

A noteworthy feature of modern practice in arranging the departmental expense accounts is avoidance of the re-distribution of fixed expenses between operating departments. Nothing is gained from distributing each month, by means of repetitive journal entries, arbitrary charges for insurance, taxes, depreciation and other fixed plant expenses. It is not within the power of foremen to exercise any control over such expenses, and there is no point, therefore, in including them with the departmental charges. Spreading these items monthly is merely swapping dollars from one account to another.

The departmental charges should be restricted to controllable expenses. The burden budget, of course, must include both controllable and fixed expenses in order to obtain proper burden rates and, for this purpose, the fixed expenses must be distributed between operating departments in the burden budget. Once this is accomplished, however, there is no further need for the distribution of fixed expenses. Instead, the accounting procedure should provide for splitting the burden absorbed by means of the normal burden rates into that part representing departmental controllable expenses and those remaining parts representing fixed expenses. The proportions in which these items are contained in the normal burden rates are established in the burden budget and can be expressed by percentages. The percentages can be applied to the burden absorbed in each department, in order to split the total into these items. Nominal expense accounts, similar to the departmental expense accounts, are provided for them and the split amounts of burden absorbed are credited to these accounts. The actual charges are placed against such credits and over-absorbed or unabsorbed burden results are placed in the nominal accounts for fixed expenses, in the same way as in the departmental expense accounts for controllable expenses.

This procedure has the advantages of maintaining the records as to fixed expenses according to the identity of the expenses and of keeping the departmental control accounts free from the variations in other than controllable expenses. An example of the resulting presentation is given in Fig. 102.

Chart Outlining Accounting Plan

When the accounting plan has been thought out, it will be advisable to set it down in the form of a graphic chart, tracing from source to destination in the accounts the flow of entries for the major transactions in accounting for operations, from the receipt of raw materials to the disposition of costs and expenses in the profit-and-loss account. Auxiliary charts upon any complicated phases of the procedure which may exist should be prepared. Such graphic drafting of the essentials of the proposed plan is useful, not only to be sure that everything of importance has been properly provided, but also for review during the installation and development of the plan in order to hew to the line and maintain the unity of the general plan. With the best of care and foresight, it will nevertheless be found necessary during the formative period to cut and fit the system and to adapt the general plan so as to meet specific conditions and problems unforeseen or not fully understood in the first place. So it is well to have these charts affording a bird's eye view of the terrain, which will give prominence to any important irregularities.

Examples of such charts are included in the Appendix, charts V, VI, VII and VIII.

Account Classification

All accounts should be arranged in an orderly sequence and symbolized. An excellent plan for arrangement and symbolization is to adopt a letter-and-number grouping, the letters being allotted to blocks of accounts in approximate balance-sheet order, coupled with numbers to indicate particular accounts, and provision for suffix numbers to sub-divide these in as much detail as is desired. The major grouping may be as follows:

Figure 103

TYPICAL ACCOUNT GROUPING

General ledger accounts:

A	Cash
	Marketable securities
	Notes and accounts receivable
B	Inventories
	Cost ledger controls
C	Prepaid expenses
	Deferred charges
D	Investments, non-current notes and accounts receivable
	Special deposits
	Non-operating properties
E	Property accounts
	Depreciation
F	Notes and accounts payable
G	Bonded indebtedness
	Other liabilities
	Reserves
H	Capital
	Surplus
J	Sales
	Returns and allowances
	Cost of goods sold
K	Warehouse and shipping expenses
L	Selling expenses
M	Administrative and general expenses
N	Miscellaneous income
	Miscellaneous charges

Cost ledger accounts:

B	General ledger controls
P	Work-in-process
R	Raw materials
S	Supplies
T	Finished stock
X	Departmental expenses (factory burden)
Y	Fixed expenses
Z	Miscellaneous cost ledger accounts

In each of these groups, designated account numbers are to be coupled with the key letters to furnish the primary classification. The numbering must be laid out so as to allow ample room for expansion. The complete account classification then would appear somewhat as follows:

FIGURE 104

TYPICAL ACCOUNT CLASSIFICATION GIVING GROUP SUB-DIVISIONS

General ledger accounts

A—Cash and receivables

A1 Cash in banks
- A109 Petty cash funds

A2 Cash placed on call

A3 Marketable securities
- A301 Interest accrued on marketable securities

A4 Notes and acceptances receivable (trade)
- A401 Interest accrued on notes and acceptances receivable (trade)

A5 (Accounts receivable—trade)
- A501 Head office accounts
- A502 Pacific coast accounts
- A507 Reserve for cash discounts
- A508 Reserve for doubtful accounts

A6 Sundry accounts receivable

B—Inventories and cost ledger controls

B1 Opening inventories

B2 Purchases of manufacturing materials and supplies

B3 Payrolls

B4 (Depreciation, taxes and insurance charged to operations)
- B401 Depreciation charged to operations
- B402 Local taxes charged to operations
- B403 Insurance charged to operations

B5 Cost ledger transfers—cost of goods sold (including unabsorbed burden)

B6 Cost ledger transfers—property accounts

B7 Cost ledger transfers—other than cost of goods sold or property accounts

B9 Cost ledger transfers—inventory adjustments

B25 Freight and cartage on merchandise shipped to Pacific warehouse

B91 Goods in transit

C—Prepaid expenses and deferred charges

C1 (Prepaid expenses)
- C101 Interest prepaid
- C102 Insurance prepaid
- C103 Taxes accrued

C2 (Deferred charges)
- C201 Rents prepaid
- C202 Advertising expenses deferred
- C203 Pattern and designing expenses deferred
- C204 Sales expenses deferred
- C208 Sundry deferred charges
- C209 Freight and cartage (clearing account)
- C210 Advances for traveling

D—Investments, non-current receivables, special deposits and non-operating properties

D1 Investments

D2 Non-current receivables
- D201 Notes receivable—employees
- D203 Accounts receivable—employees

D3 Special deposits
- D301 Compensation insurance deposit with New York state
- D302 Deposits accompanying bids for sales contracts

D4 Non-operating properties
- D401 Dwellings

E—{Property accounts / Reserves for depreciation}

Property Account	*Reserve for depreciation*	
E1		Land
E2	E3	Plant and office buildings and equipment
E4	E6	Additions to properties (in process of construction)
E201	E301	Land improvements, fences and yard construction
E202	E302	Railroad sidings and trestles
E203	E303	Buildings—brick, steel and concrete (fireproof construction) Buildings—mill construction (combustible floors) Buildings—modern and temporary structures
E204	E304	Power plant equipment
E205	E305	Machinery and equipment Tools, dies, jigs and fixtures
E206	E306	Furniture and fixtures Office machinery, etc.

Property Account	*Reserve for depreciation*	
E207	E307	Dealers' equipment
E208	E308	Automobiles and trucks
E209	E309	Patterns and designs
E210	E310	Tenement houses

F—Notes and accounts payable

F1 Notes payable to banks
  F109 Interest accrued on notes payable to banks
F3 Accounts payable—trade
  F301 Regular accounts payable—trade
F4 Taxes payable
  F401 Federal income tax
  F402 New York state franchise tax
F5 Unclaimed wages
F6 Workmen's compensation awards
F7 Sundry accounts payable
  F701 Salaries and wages accrued
  F702 Commissions accrued
  F703 Royalties accrued
  F704 Trade discounts accrued
  Note: Use "C" accounts for accruals of taxes, insurance, etc.
F9 Dividends declared

G— Bonded indebtedness; Other liabilities; Reserves (not elsewhere provided)

G1 Reserves for contingencies
G5 Reserve for industrial accident cases
G20 Special inventory reserve (entries by controller only)
G21 Reserve for inventory adjustments

H—Capital and surplus

H1 Capital stock
  H101 Capital stock outstanding—common
  H102 Capital stock held in treasury—common
H5 Profit or loss—current year
H8 Capital surplus
H9 Earned surplus
H19 Dividends—common stock

J—Sales, returns and allowances, cost of goods sold

J1 Sales
J2 Sales returned
J3 Deductions from sales
  J301 Allowances on sales
  J302 Provision for trade discounts
  J309 Freight and cartage on sales
  J310 Freight and cartage on sales from Pacific warehouse
J5 Cost of goods sold
J6 Unabsorbed burden
J7 Royalties on sales
J9 Inventory adjustments

K—Warehouse and shipping expenses
L—Selling expenses
M—Administrative and general expenses

(These symbols are to be used in conjunction with the suffix numbers given below, indicating the nature of expense.)

K1 Warehouse expenses
K2 Shipping expenses
K3 Traffic expenses

L1 Direct sales
L2 Sales promotion
L3 Advertising
L4 Sales service
L5 Market research

M1 Administrative expenses
M2 Research and development expenses

01 Salaries, officers'
02 Salaries, salesmen
03 Commissions, salesmen
04 Salaries, supervision
05 Salaries, clerical
06 Wages, indirect labor
07 Wages, maintenance and repairs
08
09
10
11 Purchased labor
12 Supplies (including stationery)
13 Telephone, telegraph and messenger service

14 Postage
15 Traveling expenses, officers'
16 Traveling expenses, salesmen's
17 Traveling expenses, general
18 Entertaining
19 Repair and maintenance materials
20 Policy claims
21 Storage and drayage
22 Freight and express
23 Conventions
24 Boxing and crating materials
25 Dues and subscriptions
26 Light and power
27 Steam and water
28 Depreciation
29 Taxes
30 Insurance—fire and general
31 Insurance—employee
32 Rent—offices
33 Rent—office equipment
34 Publications and catalogues
35 Direct mail—dealer
36 Direct mail—consumer
37 Broadsides
38 Color plates, electros, proofs
39 Window display
40 Mat service
41 Rack merchandising
42 Contract merchandising
43 Price lists
44 Stock sheets
45 Dodge reports
46 Salesmen's samples
47 Publicity bureau
48 Exhibits
49 Consumer space
50 Contract space
51 Trade space
52 Mechanical costs
53 Coöperative advertising
54 Merchandising advertising
55 Editorial coöperation
56 Consumer and trade survey
57 Prizes and bonuses
58 Overtime and lunches
59
60
61
62 Employment
63 Dispensary
64 Safety
65 Welfare
66
67
68
69
70 Directors' fees
71 Directors' expenses
72 Fees—registrar, trustees and fiscal agents
73 Official publications and expenses in relation to stockholders
74 Revenue stamps
75 Exchange
76 Donations
77 Bad debts
78 Professional services
79
80 Clubs and associations
81 Dwellings and property development expenses
82 Mailing list
83 Catalogues
84
85
86
87
88
89
90 Miscellaneous (sundry) expenses

N— { Miscellaneous income / Miscellaneous charges }

Income

N1 Miscellaneous interest earned (notes, bank balances, etc.)
N2 Interest earned on investments
N3 Dividends received
N5 Cash discounts received
N6 Bad debts recovered
N7 Gain or loss on sales of investments
N8 Gain or loss on sales of capital assets
N9 Income from non-operative properties
N10 Gain or loss on cafeteria operation
N49 Other income

Charges

N51 Miscellaneous interest accrued
N55 Provision for cash discounts on sales
N56 Expenses of non-operating properties
N57 Federal income tax
N99 Other charges

COST LEDGER ACCOUNTS

B General ledger controls
P Work-in-process
R Raw materials
S Supplies
T Finished stock
X Departmental expenses (factory burden)
Y Fixed expenses
Z Miscellaneous cost ledger accounts

(Note: The above prefixes are to be used with the detailed inventory and expense account numbers required for the individual installation.)

Advantages of the letter-and-number combination symbols are that ungainly numbers can be avoided and the group letters become familiar and associated with the class of accounts involved, which tends to reduce errors through miscoding accounts.

A novel feature of this account classification is the arrangement of the control accounts between the general ledger and the cost

ledger. These are the accounts in the "B" group. This arrangement sub-divides the inter-ledger controls into a number of accounts, which is better than having just one "factory ledger control" account, through which all inter-ledger transactions must be passed. It has the advantage of establishing the manufacturing accounts on the general ledger in the traditional formula: opening inventories, plus purchases, less closing inventories, equals cost of goods sold. The sum of the "B" accounts reflects the investment in inventories. Meanwhile, in the cost ledger, the transactions which have entered into the "B" accounts are re-classified as raw materials, supplies, work-in-process, finished stock, etc., giving all the details in support of the investment in inventories represented by the "B" account group. The "B" accounts on the general ledger offset the "B" accounts in the cost ledger, so that, upon consolidation, the "B" accounts disappear and the supporting details take their place. The general ledger and the cost ledger, of course, are independently balanced.

A "standard-cost-clearing-account" should be established in the cost ledger, in order to have the entries in basic standard costs self-balancing on the double-entry principle. When charges first are made in work-in-process or other inventory accounts at basic standard costs, corresponding credits are to be carried to the standard cost clearing account. When cost of goods sold is finally credited to the finished stock account, the corresponding basic standard cost is to be carried to the debit of the standard cost clearing account. The balance in the clearing account at all times should offset the balances in the inventory accounts at basic standard costs.

Arranging the Basic Standard Costs

The basic standard costs should not be compiled until the accounting plan has been fully outlined as described. There is a risk, if the work of compilation is begun before the proposed plan in all its applications is foreseen, that the data may be found to be unsuitably arranged for the requirements, and the work need be done over again. A well formulated plan is the task half accomplished in this, as in most, undertakings.

The form in which the data are set down in the basic standard

cost files should be given careful thought, so that all the necessary prices which are to be used shall be not only available, but shall be available in the handiest display for reference. Progressive subtotals should be included throughout for use in pricing partly completed work-in-process. The final record preferably should be typewritten.

There is not much more to be said in general about the preparation of the basic standard costs. It is a matter simply of compiling, for each product, the specifications of manufacture as to material, labor and burden, computed at the basic standard rates which have been established, as was described in an earlier chapter. The result is a measuring formula for each product, prepared for use under a definitely conceived accounting plan.

When specialty products are concerned, the basic standard cost files consist of the basic rates merely, i.e., material rates, labor rates by operation, burden rates and machine possibilities. These are assembled into formulas when orders for products are obtained and specifications are determined.

It will be a wise precaution to make a rule that basic standard cost data shall not be supplied when information as to the cost of products is to be furnished to other departments as, for example, to the sales department. Such requests should be met by furnishing the converted figures—that is, the costs after the correcting ratios have been applied to the basic formulas. This will obviate any tendency that might exist toward mistaking the basic standard cost formulas for costs and discounting the true figures.

CHAPTER XIII

DETERMINING NORMAL CAPACITY

In modern cost accounting methods the expedient of introducing burden into costs of manufacture by means of equalized and stable rates established in advance, at levels thought to be normal, is obviously useful to avoid the disturbing fluctuations in operating costs which arise from increases or decreases in operating activity. Such fluctuations cause costs to be more difficult to analyze and understand. It is also more nearly correct to use normal burden rates for costing purposes. The seasonal and monthly variations in indirect plant expenses should not be applied to the products made at arbitrary periods, especially when the expenses in which the variations occur can not be definitely attached to separate products and therefore must be brought indirectly into account. Nor can the increase in operating costs which accompanies a decline in volume (or the decrease in operating costs which accompanies a gain in volume) correctly be attached at arbitrary periods to the particular products then being made. The primary causes of such variations are extraneous to manufacture, and it is not correct to load the cost of unused plant upon the immediate costs of the articles made while the condition prevails. Losses of this kind can not be recovered from the customer in the selling prices of certain products in any such casual condition. They must be recouped on the whole in the profit margin realized on all products.

It has been seen in previous chapters that the budgeting of burden and use of normal burden rates has advantages in the development of information for aid in operating control as well as for costing purposes.

Some perplexing questions arise, when establishing the budget and the rates, in determining the operating level which is to be regarded as normal capacity. Plainly enough, 100% would not be advisable—that is to say, the plant can not be operated with a maximum force of employees the full number of days or hours in the year. There will be losses in the operating time theoretically available, arising from interruptions and delays due to many causes, which can not be prevented—from break-downs in machinery and equipment, which consume time in effecting the necessary repairs; from processing and production mishaps which reduce output; from lack of sales demand, which leads to surplus capacity, and from other causes. Then what percentage of the theoretically maximum capacity should be used? What discount from 100% should be taken, and on what reasoning, to determine normal capacity?

Several questions must be given consideration:

1 (a). Shall the normal provide, as a deduction from a theoretical maximum, sufficient to allow only for ordinary operating interruptions, thus bringing the normal level to a maximum *possible* of attainment, or (b) shall it provide in the deduction a further allowance for capacity apt to remain unused because of insufficient sales, which would bring the normal level down to a maximum *probable* of attainment? Briefly, in other words, should normal capacity be regarded as capacity to manufacture or capacity to sell?

2 (a). Shall the normal capacity be set for each department with due regard to the capacities of other departments, or (b) shall the normal capacity be set for each department without giving consideration to other departments, or (c) shall the normal capacity be set for every department at the same arbitrary level?

3. After the foregoing considerations have been weighed, shall normal capacity be set (a) at a level suitable for the industry, based upon the experience of a representative number of companies, or (b) at the level suitable to a particular plant, based upon the experience of an individual company?

4. And, as a variation of the preceding, in cases where numbers of plants are operated by one company, shall normal capacity be set (a) for the company as a whole, based upon an average experience as to all plants, or (b) for each plant individually?

Capacity to Manufacture vs. Capacity to Sell

In the first instance, it will be well to segregate and eliminate entirely from consideration any idle space or evidently unusable equipment. As to the remainder, the usable space and equipment, it is necessary at the outset to determine whether normal capacity shall be set strictly on a manufacturing basis, without regard to sales demand, or on the basis of the probable use which will be made of existing facilities, with regard for the fact that the capacity to manufacture is greater than the quantity of products which can be sold.

There are advantages and disadvantages in setting normal capacity on the basis of manufacturing possibility alone. In favor of this course it may be pointed out that costs are then computed on the lowest burden basis, which is auspicious for quotation purposes. When burden is computed for the utmost practically attainable manufacturing capacity, no question of a possibly lower burden cost through greater sales volume enters: more products could not be made, notwithstanding the size of the order, because the total output already is anticipated in the burden rates.

Another advantage in basing the normal level at the capacity to manufacture is that in the ensuing accounting procedure the figures will disclose over-capacity. The amount of burden unabsorbed and the ratio of absorbed to normal burden will show the extent to which available facilities are not being used and in this way may stimulate the obtaining of further business—"fillers"—or new products in sufficient quantity to make up for the losses. Lack of balance in activity between departments will also be apparent from the same figures.

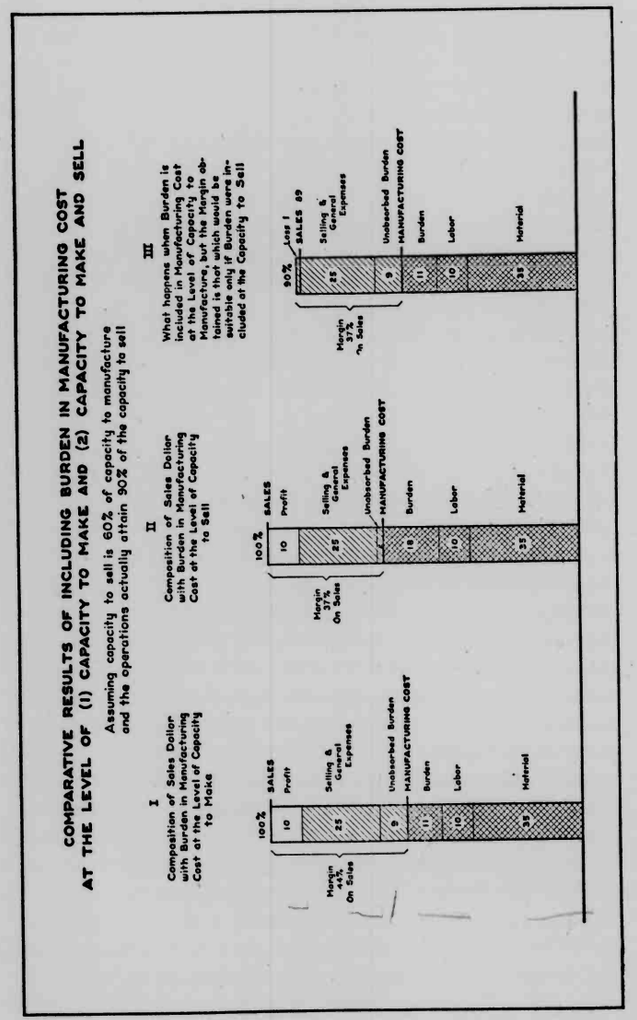
Capacity to manufacture is more definitely ascertainable than capacity to sell. The former is limited by the equipment and facilities which exist, whereas the latter is subject to the uncertainties of competition and demand.

Capacity to manufacture changes less frequently than will the capacity to sell and, therefore, in this sense is more stable.

The principal disadvantage of using capacity to manufacture as the basis is the risk of misconception or of forgetting that this level is the optimum, not apt to be realized. In the preponderant majority of cases the capacity to manufacture is greater than the capacity to sell. The tremendous industrial development in the United States during the last fifty years, through the mechanization of manufacturing methods and the intensive study of management in the field of production, given added impetus by the World War during the last half of this period, has created in almost all manufacturing industries a capacity to produce far in excess of the demand. Entirely aside from a falling away of demand for whatever reason, over-capacity will exist because plants are not built or expanded to the lowest limits of early prospective sales, but rather with an eye to the future and an expected growth. These causes bring about a more or less permanent over-capacity, that is, permanent as to existence, if not as to degree. When over-capacity is enhanced by a falling away in demand, through business depression, style trends or developments in competitive products, the disparity between the capacity to make and the capacity to sell is so great that the former becomes enirely imaginary as a basis for normal burden. On this basis large losses would develop in the accounts for unabsorbed burden, which in the end must be covered by adequately wider profit margins between selling prices and the low costs. (A reactive thought at this point may be that competition prevents widening the profit margin. But we are not concerned in this reasoning with any question of raising the selling price. Whatever margin is obtainable between the given price level and the high cost basis, must be widened in conjunction with the low cost basis, which does not alter the price level, to maintain the profit if manufacturing capacity is not attained.) The risk in using the low costs is that this necessity will be overlooked, and forgotten until the unpleasant disclosure of losses at the end of the year drives home the truth. Then it will be understood that it would have been more conservative to set the normal level at the capacity to make and sell, which will result in higher costs but lower unabsorbed burden.

If the normal level is set at capacity to manufacture the unabsorbed burden variation will consist of an amount corresponding to the difference between the capacity to make and the capacity to make and sell, plus an amount proportionate to any failure to realize the expected sales. Whereas, if the normal level is set at ca-

FIGURE 105



pacity to make and sell, unabsorbed burden will be confined to the amount proportionate to the sales not realized.

Of course in the last analysis, the difference in the two methods is merely in what amount shall be included in manufacturing costs and what amount must come out of margin. But, as already stated, when the lower burden basis is used, there is a risk that it will be forgotten that due provision must be made in the margin for any failure to attain full manufacturing capacity, if profit is to be maintained. The distinction in calculation, and the effect if it be overlooked, are brought out graphically in the diagram, Fig. 105, opposite.

This disadvantage is so important, so fraught with the possibility of producing misleading or unduly optimistic estimates, that it usually outweighs the advantages cited and influences the decision to set the normal level on the conservative basis of capacity to make and sell.

Interdependent Departmental Capacities

When a decision has been reached as to the proper level for normal capacity, consideration must be given to the question whether the capacity to be set for each department in the plant is to be modified to conform with the normal for other departments. Rarely will the capacities of the several departments in a plant be found in such perfect balance that when the capacities are determined separately they will be correct relatively. A foundry, for example, may have a greater capacity for producing castings than is necessary to meet the maximum requirements of subsequent operations. Then the policy with regard to the operation of the foundry must be considered. If the policy is to produce castings for outside customers as a business undertaking, the capacity of the foundry may be set with this additional volume in view, and its over-capacity as it relates to subsequent shop operations would be reviewed. If, on the other hand, the policy for the foundry is not to seek any outside business and to confine production to the requirements of the plant, it would obviously be logical to set the normal level for the foundry at the output that will be used within the plant. This is equivalent to saying that there is no market demand for the extra capacity of the foundry.

A similar situation often exists in assembling and finishing departments, in which the facilities extensive enough to meet peak demand are therefore greater than normally necessary to take care of the production from preceding departments. Over-capacity of this kind can seldom be put to any other use, and accordingly it would not be sensible to set the normal for such departments at any higher level than those of the departments from which products are contributed for assembling or finishing.

When a department is a feeding department, or a link in a series of operations which are more or less continuous (or at least successive) it will probably be best to set the normal for the respective departments with regard to them all, which is to say that the normal will be determined by the "bottle neck": the department with the lowest capacity. For example, in rug making, the department for threading in preparation for weaving may actually have a capacity for an output greater than can be handled on the looms. In such a case it would be purposeless to have the threading capacity any greater than would be commensurate with loom capacity, for surplus capacity of the threading department could not be used.

On the other hand, if the output of a feeding department or a department in a series of operations consists of products which are salable or are transferable to a number of other departments, these abilities would have to be taken into account.

The practical aspects of the situation will generally be a guide to the proper course. Whenever departments are entirely interdependent, as to either input or output, their capacities should be set with regard to each other.

Independent Departmental Capacity

When the relation between departments is not so close as practically to limit the operations of a department by the input or output of others, the course is open to set the levels of normal capacity independently on an individual footing. This will be the desirable course, especially when products are made which are salable at intermediate stages. For instance, in textile industries the capacities of spinning and weaving departments may be set separately. Often the two are not completely interdependent, although the products

of the spinning operations are transferred to the weaving operations. Yarn spun may be sold, and, conversely, spun yarn may be purchased in the open market. Then the normal capacity of the one department does not limit that of the other. To bring out the distinction it may be added that the relationship is more remote than that between the weaving and finishing departments, where the finishing capacity is limited by the weaving capacity, or that between the spinning and carding departments, where the capacity of the former is limited by that of the latter. In both cases normal capacities must be set with due regard to the interdependent relationship.

Different schedules of operating hours, such as in the case of multi-shift and continuous operations, will usually require separate consideration in the establishment of the normal capacity level. Even when all the operations are continuous (as in some chemical industries), it may be necessary to set separate capacities for the processing divisions, because the relation of production of the divers products to available capacity will vary, especially when the market is taken into account in determining normal. The fact that the operations are continuous does not necessarily insure that the levels of normal capacity will be uniform for all products.

Although, in cases such as these, departmental normal levels may be separately determined, in a sense they are never quite independently determined. The only case in which complete independence of consideration would prevail would be one in which each department was accorded its own level on the basis of capacity to manufacture, irrespective of other considerations. This basis will seldom be advisable, for reasons which have been given. In the majority of cases the capacity basis will be partly separate and partly interdependent. The separate capacity levels will usually follow the lines of prominent plant sub-divisions or major operational groups, corresponding to the primary natural product classification. Interdependent levels then will be set within the plant divisions or operational groups, which will comprise sequent or connected departments and production centers. Both will be done with an eye to the correct proportions between activities in the conduct of the business as a whole.

Uniform Arbitrary Capacity Level

The level for normal capacity is sometimes established at an arbitrary point, uniform for all departments. The uniform feature applies to the discount to be taken from a theoretical maximum capacity. For instance, it may be decided to adopt throughout a level of 75% for 52 weeks per annum. This prescribes the discount. The operating hours for each department then are established at this discount, but of course separately for the equipment or facilities and running schedule in each department. When this method can be used, it has the advantage of treating all departments alike, removing any possibility of contention on this score, and placing comparisons on the same level for all departments. These advantages are enhanced if a number of plants having similar departments are owned by one company. Differences in normal burden rates between comparable equipment then are confined to differences in expense, because the numbers of operating hours are held uniform as to capacity. Differences in the burden costs of comparable operations on the same products at different points are traceable to this expense difference and any difference in the rate of output, without a further variable arising from different capacity levels. However, the conditions must be such that a uniform discount is fairly applicable; otherwise what is gained through uniformity may be lost by the introduction of other difficulties which present themselves because the uniform discount is not correct for all kinds of equipment.

The same discount can not be taken for all kinds of machinery and manufacturing equipment. Even if the normal capacity level is based solely upon capacity to manufacture, the allowance for ordinary operating interruptions will vary with the nature of the facilities and character of the work, at least from 10% to 33 1/3% on a theoretical maximum capacity. This happens not only in different kinds of equipment, but to some extent as well in different styles or makes of equipment for the same purposes; so that a difference may have to be recognized in the allowances to be made from a theoretical maximum, which would result in different normal capacity levels. If in these conditions a uniform level of

75% is established, whereas in one instance it should be 66 2/3% and in another 85%, let us say as between steam drop forge hammers and machine finishing equipment, obviously the burden rates in both instances are affected—those in the former are too low and those in the latter are too high. Unabsorbed burden on the forging operations and over-absorbed burden on the finishing operations will result from this error alone.

Another condition which must be considered is that frequently the operating capacity obtainable from specified equipment will vary in different localities, on account of characteristic differences as to skill and energy in the labor employed. This would result in a difference between plants in the normal operating capacity obtainable from identical equipment.

It may be that manufacturing capacity can not be uniformly set, but the allowance to be made for over-capacity when the market is taken into account can be uniformly applied. For instance, the proper manufacturing capacity level, having regard to the nature of the equipment, may be 70 in one department and 85 in others, while the capacity on the whole to sell the products made in the plant is only 70% of the manufacturing capacity. Then a uniform allowance for over-capacity may be made, setting the normal for the first department at 50 and for the others at 60. Or, to extend the illustration to a case wherein a number of plants exist, the over-capacity at all plants may not be uniform; that is, the capacity to sell may be 70% of the capacity to manufacture for the company as a whole, but the shipments from individual plants may deviate from this rate. Nevertheless it may be better in such circumstances to reduce the manufacturing capacity at each plant uniformly to allow for the general over-capacity and to let the deviation in shipments influence the amount of unabsorbed burden disclosed. Greater shipments from a plant then would reduce unabsorbed burden, while lower shipments would increase unabsorbed burden.

A uniform basis can not be used if the normal is to be set at the level of capacity to make and sell and this capacity differs between departments—that is to say, if the manufacturing capacity is not the

same between departments and in addition the surplus capacity for the products of the departments is not uniform. Then it is not possible to use a uniform capacity level, unless it happens that the manufacturing and marketing disparities compensate so as to result in the same gross discount.

Company Uniform Capacity Level

In a way the question whether or not a uniform level for normal capacity shall be established for all plants, when a company owns a number of them, is a phase or an extension of the preceding question. It deserves a separate caption, however, because the question is analogous but not identical. The issue to be decided in the preceding instance was whether the level of normal capacity should be set at a uniform point for all departments, either in one plant or in a number of plants. The present issue is whether the normal level shall be set uniformly for a number of plants with respect to similar departments. This does not imply that all departments are to be allotted the same normal level but merely that like departments at different plants shall have like normals.

No difficulty arises if the uniform normal capacity level selected is appropriate for all the plants. When this is not the case, as it will probably be found if the plants are in widely scattered sections of the country, the problems which have been referred to in the preceding section will arise. If the normal capacity levels are adjusted to the conditions at each plant, it may be desirable to set up as well a company "par", so as to bring out the respective deviations from a common base. Conversely, if a company "par" is used for the establishment of the normal basis at all plants, the deviations which are the natural accompaniment of local conditions and therefore are normal must be borne in mind or overcome by correction factors. The former method has the advantage of providing burden rates that are consonant with the conditions at each plant.

Industry Uniform Capacity Level

Another method sometimes considered is to establish the level of normal capacity by departments according to the experience of a

representative number of companies in an industry. If the average, or composite, or significant level thus determined is suitable for the departments in a particular plant—that is to say, if the methods in the industry are fairly common and the manufacturing equipment and processes are similar—this course has the advantage of permitting wider comparisons. Burden unabsorbed or over-absorbed will then indicate whether performance is below or above the common standard, and comparisons of the degree of burden variation will indicate the relative positions of the companies in this respect. Also differences in burden rates, disclosed upon comparison between companies using this basis, can be attributed to differences in the pertinent expenses (assuming uniform classification of expenses).

On the other hand, a uniform normal level for the industry may not be properly applicable to an individual plant, because of marked differences in facilities, especially if the industry level is to include an allowance for over-capacity to manufacture. The latter will not be uniform for all companies in the industry. Then the difficulties, which must be met if the normal capacity level is to be set at any point which is not appropriate individually, have to be considered in reaching a decision on this question.

Recapitulation

Summarizing the foregoing considerations, it appears that the questions which are to be decided in determining normal capacity are:

(1) whether normal shall be set on the basis of capacity to make or capacity to make and sell;
(2) whether the normals for individual departments shall be set interdependently or independently as between departments, or at a common level;
(3) whether the normal level shall be based on conditions peculiar to the plant or peculiar to the industry, and
(4) in cases where a number of plants are operated by one company, whether the normal level shall be peculiar to each plant or common for the company.

The only conclusions which can be put forward in a general way are that the level of normal capacity based upon ability to make and sell is conservative, and that the more nearly the normal selected fits the operating conditions in each instance, the more nearly correct will be the resulting burden rates.

CHAPTER XIV

REPORTING PRODUCTION AND INTERDEPARTMENTAL TRANSFERS; INTERDEPARTMENTAL PROFITS [1]

Reporting Production and Transfers

A phase of the accounting procedure which will require forethought is the obtaining of suitable reports on production and transfers of products between departments, inasmuch as the basic standard costs which are to be the measures of effectiveness in performance are computed from them. It is most desirable to have the production data emanate from the same sources and come through the same channels as data used in production control. Usually, with a few modifications in the form and arrangement of the reports, the same information may be made to serve both purposes.

The nature of these reports obviously must depend upon the circumstances, and their form and the routine for handling them will be peculiar to the conditions in each case. A few such forms are illustrated (chart IX, Appendix) purely by way of suggestion. The details to be contained in the production reports and the points from which such reports are to be rendered, as well as whether they are to be daily, weekly, or at other intervals, will be decided in accordance with shop requirements and the outline of the accounting plan.

When production reports and reports of transfers between departments have been extended at basic standard costs, they are to be converted to the level of actual costs by applying appropriate cost ratios, so that, in effect, the transfers are made at actual costs. There

[1] The material in this chapter relating to interdepartmental profits is taken by permission from an article which appeared in *The Journal of Accountancy*, July, 1929.

is usually no question involved as to the practice of transferring deliveries from work-in-process to finished stock at actual costs, but sometimes there is a question whether it is or is not as advantageous to transfer products delivered from one department to another at cost plus a profit.

Interdepartmental Profits

When the completed products of a manufacturing department are either marketable or transferable to adjacent departments for further processing, is it desirable to transfer the products at selling prices, or is it better to transfer them at cost?

A number of interesting problems arise in the attempt to find an answer to this question. Some considerations at first appear to be in favor of treating successive departments for the manufacture of marketable products as separate commercial units and each department as an operation by itself. It is plausible to argue that when some of the products made in a department are sold to customers at a profit, while some of the products are turned over to other departments, a profit should be credited to the producing department for both transactions. But other considerations soon present themselves and turn the judgment in the opposite direction, making it seem advantageous to handle interdepartmental transactions only at cost throughout.

The further one enters into the subject, the more perplexing it becomes. The object in this chapter is to refer to a number of the reasons for and against each basis of computing interdepartmental profits, with the intention of stating the problems so as to invite further study of them, not in the hope of offering a solution at this time that will be generally acceptable.

It is to be understood at the outset that the question does not involve the propriety of eliminating internal profits from the inventories. The soundness of the principle that a profit does not arise until products have been sold is undisputed. The question is whether the benefits to be obtained from the plan will justify its adoption, with the understanding that, if it does, a suitable method of obtaining a correct statement of earnings must be devised.

The question is not an academic one. On the contrary, it is very

practical and is of increasing importance in the conditions which develop as the result of industrial expansion and combination. The conditions may vary from the simple to the complex. For example, it is not unusual in the metal-working industries to find that when a plant includes a foundry, castings are delivered to the machining departments at prices affected by those at which the castings could be bought from an outside foundry. On this reasoning, a separate profit or loss can be expressed for the foundry as a distinct venture. This may be taken as a simple case. Or a printing establishment may have departments containing job presses, cylinder presses and rotary presses. On each of these types of equipment certain forms of printing are done. Some of these forms are completed within one department, but more extensive printing may require the use of the facilities of all the departments to produce the finished book or magazine.

Extremely complex situations are met when a string of plants is operated by one company or by associated companies under a coördinated management. Usually, in such cases, the properties formerly were those of separate and competing businesses. Therefore, not only is it probable that the products of the combined enterprise are numerous and are made in large quantities, but it is probable as well that similar departments exist and that the same kinds of products are made at different plants. For example, a corporation engaged in the making of copper-wire products, may own a number of plants. At one plant, the major departments may consist of a rod-mill, a wire-mill and a rubber-covering department. In the rod-mill, copper bars, which are about five inches square and five feet long, are drawn through dies into copper rods, say, one-quarter inch in diameter. The rods are salable in this form, or they may be transferred to the wire-mill. In the wire-mill, the copper rods are drawn through finer dies into copper wire of many different sizes. The copper wires can be sold at this stage, or they can be transferred to the rubber-covering department, where insulation of various kinds is applied.

At another plant of the same organization, the first department, the rod-mill, may be lacking, so that it is necessary to buy copper rods as raw material. At still another plant, the facilities may begin

at the stage of insulating, so that for this plant wire must be bought as raw material—wire similar to that which can be produced in the second department of the first plant.

It will be evident that, in situations of this kind, the principal departments are major commercial operations which are comparable to individual competitive businesses, the products of which are sold in a market subject to the competition of other concerns engaged mainly or solely in making the same kind of products which are made by one of the departments.

The question as stated, however, is not put with regard to the transfers of products between different plants. When the transfers are beween different plants, it may be advisable to ship at market prices or at a preferred discount, so as to afford a profit to the producing plant; particularly if there are separate corporate entities with minority stock-holding interests.

When similar reasoning is applied to the question whether or not it is advisable to adopt a like course with reference to transfers of products between departments in the same plant, the advantages and disadvantages are not so clear. It is equally desirable to gauge the adequacy of return and the effectiveness of operation in major departments, but some difficulties come up if this is done by the introduction of an anticipated profit in the cost of products to be further processed in the same plant before being sold.

The principal purposes which may be advanced in favor of taking interdepartmental profits are (1) to judge the effectiveness of management, (2) to determine manufacture policy and (3) to measure the adequacy of return upon investment.

Judging the Effectiveness of Management

Net earnings—the last figure on the last line—are of indubitable interest. The expression has a popular appeal. It is easy to read and, of course, it is the ultimate criterion of management.

It is to be remembered also that a knowledge of and a share in profits by leading executives and department heads is an excellent thing. When this is effected under a well formulated plan, it becomes one of the important factors in management to obtain adequate control.

If products received from prior departments are, in effect, bought from those departments as if they were bought outside and, in turn, if the products of the immediate department are sold, either to customers or to other departments, the resulting profit is expressed for each department on its own footing, and the effectiveness of operation may be apparent. The amount of the departmental profit, taken in relation to the capital invested for the department, will indicate whether the rate of return is satisfactory or unsatisfactory. In the case of products on which insufficient margins are obtained, or on which even a loss may be incurred, the practice of turning them over at market prices will place the loss in the account of the department in which the article is made, instead of passing the loss along to the department which has the ultimate product to sell.

On the other hand, opposed to these reasons in favor of charging interdepartmental profits (with particular reference to judging the effectiveness of management), are several considerations. First, if this course is to be adopted, the difference between production and sales must be taken into account. That is, the profit must be computed upon production irrespective of sales. Products must be billed to warehouses or process storerooms as well as to other departments. Otherwise a low profit may appear at a time of high production, or vice versa. The procedure will cause patent difficulties in the setting up of inventories at selling prices with corresponding reserves for profit.

The expression of departmental profit may be misleading, because the results will be subject to influences which have no bearing on the effectiveness of manufacture. Sales or administrative policy may enter, causing losses or unfavorable variances which may fall in particular departments. It is quite possible in these circumstances to show a loss for a department which has really been operated remarkably well. This will be discouraging, if profit is to be the measure of accomplishment.

The practice of measuring accomplishment by profits puts a premium upon departmental consciousness. It may lead to bickering between department heads as to the prices which should be charged for products and as to which products should be made and which

should not be made. It will be natural for department heads, if they are to be judged by their profit showing, to feel that they should have a voice in decisions relating to products made in their departments which will affect their profit showing. This would have a tendency toward disorganization, because manufacturing men would become involved in questions of sales policy.

It should be noted, too, that if departmental profit is to be taken it will be necessary to make suitable charges against it for a share of the shipping, selling and general expenses. Otherwise the margin on internal transfers will be clear gain to the producing department, while all the expenses of selling, shipping and collecting incurred later will fall on another department.

Determining Manufacturing Policy

The second object is to determine manufacturing policy. Comparisons will be sought between the costs of like products made at one plant and at another, either to decide whether the methods employed at one are more efficient than at the other or to decide which is the place at which to manufacture most advantageously. If at some plants materials must be bought, while at others they are fabricated, the materials will be higher in cost at the plants where they have to be bought outside. The introduction of a profit to the fabricating departments, so that the cost of materials to subsequent departments will be as if the materials had to be bought, will smooth out the disparity between the plants and facilitate the comparison of costs. Then, too, the benefit of cost to make over cost to buy will be disclosed by the extent of the profit on products transferred.

Counter to these arguments it may be said that comparisons between the costs of products made at different points can not well be made by examining total costs. It is always necessary, in order to reach conclusions, to make such compatisons in more detail. When this is done, the disparity which is due to buying materials outside at one plant and fabricating them at another can be brought out, if the accounting procedure embodies the features of standard costs, so that the effect of such a condition will be apparent. It is not necessary to transfer the products at market for the purpose

of cost comparison. Nor is it necessary to do so to ascertain the gain in cost to make over cost to buy, for this can be computed equally well by estimating the difference in costs for the quantities involved. Moreover, it may be good policy to manufacture materials, even though at a higher cost than that at which the materials could be bought, for the sake of control over the fabricating processes.

Measuring Return Upon Investment

The third object in computing interdepartmental profits is to ascertain whether or not a proper return upon capital invested is being realized by departments. If interdepartmental profits are taken, then, as mentioned, the net earnings of each department may be set against the capital invested. The information is important, either for fixing selling prices or, when selling prices are set, for deciding whether a branch of activity is profitable or not. The question is whether or not the proposed means of obtaining the information is the best.

If each department were to transfer products at prices equivalent to selling prices at the current stage of manufacture, it would furnish a basis for setting subsequent selling prices, or for reading subsequent profits, upon progressive costs that presumably would include provision for return on the investment in prior processing departments. If this provision were true, and it were safe to rely upon it, this consideration would have weight. The trouble is that the proposed basis may be misleading, for any of the following reasons:

(a) The margin on the products of a department may be adequate in the average, while the transfers from that department may not conform to the average. Products are frequently made in a range of sizes, and in such cases the products are sold at prices which do not afford the same percentage of profit for each item. The curve of selling prices tends to be straighter than the curve of costs. The profit margin may be adequate on the production as a whole, if it is enough wider at the points of volume to compensate for the narrower margins on the lower volume of products necessary to complete the class.

The basis would provide for profits but not for losses. That is to say, if products are to be credited to departments at selling prices,

what happens if some of the products cost more than their selling prices? The excess is retained as a departmental loss, and the effect of this retention will not be incorporated in the cost of the ultimate product in some remote department.

(b) The margins may be inadequate in prior departments, but compensating wider margins may be obtainable on the products of subsequent departments, so that on the whole the manufacture and sale of the ultimate products may result in a profit adequate for the entire investment.

The introduction of interdepartmental profits may not only result in an erroneous basis for reckoning later profit margins, but the expedient may be ineffectual for the immediate purpose as well, because (c) it will be discounted, and (d) it will prevent a knowledge of cost. If interdepartmental profits are introduced into costs, the policy will be known, and the tendency will be to discount the effect of such introductions. It will be hard to discount the augmented costs accurately, for, as when interest is included in costs, it is impracticable to learn exactly how much of the foreign element is hidden in any given case.

While it is true that a cost often is not the immediate basis for setting a selling price, it is nevertheless a source of comfort to have a trustworthy knowledge of cost, if only to serve as a last line of retreat. The hazard of retreating to a line, whose exact location is uncertain, is obvious.

Conclusion

On the whole, as thought is given to these various considerations, the impression grows that in the taking of departmental profits there is danger of merely swapping new troubles for old and familiar ones.

For example, there will be the difficulties of determining the selling prices, in case it is the custom in the industry to base quotations upon changing market prices of materials, such as cotton, rubber, copper, etc., or of special products; and of deciding where departmentalization is to stop. One plant may make tools and dies for use; another may buy them; a third may have a department for making tools and dies for use and for sale to customers. Or, again, at one

plant power may be purchased; at another, power may be produced. Finally, what is to be done when transfers of products are made from a department in which they are manufactured to another department where no further manufacturing is done but whither the goods are consigned as the most convenient way of selling them?

To recapitulate, there are these considerations:

Pro	*Con*
(1) that to judge the effectiveness of management, an expression of earnings is a familiar and useful gauge,	but that an expression of profit by departments may not be truly indicative of the effectiveness of management;
(2) that to determine manufacturing policies, certain disparities in operating conditions can be smoothed out in order to put departments on a comparable basis as to materials,	but that the desired comparisons can be made at costs suitably analyzed; and
(3) that to measure the adequacy of return on capital invested, an expression of profit according to departments in which the products are made can be provided, instead of according to the departments in which the articles were sold,	but that such expression of profit will not be a more distinct indication of the adequacy of return by products than the more conventional accounting.

In conclusion, therefore, if it be admitted that the proposed expedient will not serve more clearly to demonstrate the effectiveness of management and is not needed to determine manufacturing policy and will not bring out the adequacy of return on capital invested any more truly than the system of adhering strictly to costs, then the net result of its adoption would be greater complication without equal benefit: a step in the wrong direction.

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APPENDIX

Schedule		Calculations in detail supporting analysis of variations in profits
Chart	I	Typical standard-cost forms MISSING
Chart	II	Exhibit illustrating the main principles of cost analysis by means of standard costs
Chart	III	Exhibit illustrating principal features of difference between methods of using standard costs (1) as ideals and (2) as basic measures
Chart	IV	Flow chart showing manufacturing processes in refining corn products
Charts	V to VIII	Outlines of cost-accounting plans
Chart	IX	Typical forms of production reports
Charts	X and XI	Typical pages of burden budget

SEP 8 1932

APPENDIX

ANALYSIS OF VARIATIONS IN PROFITS
CLASS A

Calculations showing the results had the several variations not occurred, proving the correctness of the analysis

Analysis (Fig. 49)		*Volume i.e., had volume been as expected*	*Assortment*	*Price*	*Cost*	*Assortment and price*	*Assortment and cost*	*Assortment and volume*
Volume	$ 209	eV 110	aV 115	aV 115	aV 115	aV 115	aV 115	eV 110
Assortment	720	aA 98.7	eA 100	aA 98.7	aA 98.7	eA 100	eA 100	eA 100
Price	568	sS 108.56	sS 115	sS 113.5	sS 113.5	sS 115	sS 115	sS 110
Cost	1,380	aP 96	aP 96	aP 95	aP 96	eP 95	aP 96	aP 96
Incidental:		S 104.22	S 110.4	S 107.825	S 108.96	S 109.25	S 110.4	S 105.6
Volume-assortment	31	aC 108	aC 108	aC 108	eC 105	aC 108	eC 105	aC 108
Price	25							
Cost	60							
Price-assortment	7	S $52,111	S 55,200	S 53,912	S 54,480	S 54,625	S 55,200	S 52,800
		C 47,520	C 49,680	C 49,680	C 48,300	C 49,680	C 48,300	C 47,520
Total	$1,250	M $ 4,591	M 5,520	M 4,232	M 6,180	M 4,945	M 6,900	M 5,280
		aM 4,800	aM 4,800	aM 4,800	aM 4,800	aM 4,800	aM 4,800	aM 4,800
		$ 209	720	568	1,380	145	2,100	480

AMOUNTS SHOWN BY ANALYSIS

$209	720	568	1,380	720	720	209
				568	1,380	31
				152	2,100	240
				7		720
				145		480

V = Volume
A = Assortment
P = Price
C = Cost
S = Sales
sS = Standard sales
a = actual
e = expected
M = Margin

APPENDIX

ANALYSIS OF VARIATIONS IN PROFITS—(*Continued*)

CLASS A

Calculations showing the results had the several variations not occurred, proving the correctness of the analysis

Analysis (Fig. 49)		*Price and cost*	*Price and and volume*	*Cost and volume*	*Assortment price and cost i.e., had volume alone changed*	*Volume, price and cost i.e., had assortment alone changed*	*Volume, assortment and cost i.e., had price alone changed*	*Volume, assortment and price i.e., had cost alone changed*
Volume	$ 209	aV 115	eV 110	eV 110	aV 115	eV 110	eV 110	eV 110
Assortment	*720*	aA 98.7	aA 98.7	aA 98.7	eA 100	aA 98.7	eA 100	eA 100
Price	568	sS 113.5	sS 108.56	sS 108.56	sS 115	sS 108.56	sS 110	sS 110
Cost	*1,380*	eP 95	eP 95	aP 96	eP 95	eP 95	aP 96	eP 95
Incidental:		S 107.825	S 103.132	S 104.22	S 109.25	S 103.132	S 105.6	S 104.5
Volume-assortment	31	aC 108	aC 108	eC 105	eC 105	eC 105	eC 105	aC 108
Price	*25*							
Cost	60							
Price-assortment	7	S $53,912	S 51,568	S 52,111	S 54,625	S 51,568	S 52,800	S 52,250
		C 48,300	C 47,520	C 46,200	C 48,300	C 46,200	C 46,200	C 47,520
Total	*$1,250*	M 5,612	M 4,048	M 5,911	M 6,325	M 5,368	M 6,600	M 4,730
		aM 4,800	aM 4,800	aM 4,800	aM 4,800	aM 4,800	aM 4,800	aM 4,800
		$ 812	*752*	1,111	1,525	568	1,800	*70*

AMOUNTS SHOWN BY ANALYSIS

$ 568	209	209	*720*	209	209	209
1,380	*25*	60	568	*25*	31	31
812	184	269	7	60 35	60	*25*
	568	*1,380*	*1,380*	244	300	215
	752	*1,111*	*1,525*	568	*720*	*720*
			or:	812	*1,380*	568
			209	*1,380*	*1,800*	7
			66	*568*	or:	70
			275	or:	568	or:
			1,250	*720*	7	*1,380*
			1,525	31	575	60
				7	*25*	*1,320*
				1,250	550	1,250
				568	1,250	70
					1,800	

V = Volume
A = Assortment
P = Price
C = Cost
S = Sales
sS = Standard sales
a = actual
e = expected
M = Margin

CHART I

SOME TYPICAL STANDARD COST FORMS

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STANDARD COST SHEET
RUBBER COVERED WIRE

DESCRIPTION _____ SIZE _____

DATE _____

FINISHED STOCK FROM PRIOR DEPARTMENTS			LABOR AND EXPENSE	CUMULATIVE L. & E.	COST BASIS — 1000 FT, 100 LBS.	OTHER MATERIALS	COPPER	TOTAL
SIZE	DESCRIPTION	QUANTITY						

LABOR & EXPENSE _____ DEPT.			MATERIALS _____ DEPT.			
✓ OPERATION	DIRECT LABOR	DEPT. EXPENSE	✓ DESCRIPTION	WEIGHT PER M. FEET	STANDARD PRICE	UNIT
STRIP COVERING			RUBBER COMPOUND			
BRAIDING			COTTON			
COILING			JUTE			
VULCANIZING			SATURANT			
SATURATING			FINISH			
FINISHING			WRAPPING PAPER			
COILING			BUNDLING PAPER			
TESTING OR SPARKING			TWINE			
COILING OR REELING			STAMP			
TWISTING						
BRAIDING						
SATURATING						
FINISHING						
WRAPPING						
BUNDLING						

COST OF FIN. STOCK | OPERATIONS | MAT'L—KIND & QUANTITY | L & E PRICES | MAT'L PRICES | EXTENSIONS | FOOTINGS | FINAL O. K.

STD. COST THIS DEPT.

TOTAL STANDARD COST

SPECIAL FEATURES:

STANDARD UNIT COST
(UNIT - ONE)

SYMBOL NO.	NAME OF PART		PART CLASS
STD. QUAN.	KIND OF MATERIAL	MATL. CLASS	GROUP

DIA	THICK	WIDTH	LENGTH	WEIGHT	STD. COST PER LB	STD. MATL. UNIT COST

DEPT	OPER.		STD - LABOR	STD. - EXPENSE	CUMULATIVE
		TOTAL STANDARD COST			

SYMBOL NUMBERS

STANDARD COST SHEET (MANUFACTURED PARTS)
UNIT - ONE

TYPE OF MACHINE		NAME OF PART	PT. CLASS	STD. QUANTITY	SYMBOL NO
PIECES USED					
ROUTING		USE CASTING	DRAWING NO		DATE

KIND OF MATERIAL	WEIGHT PER FOOT	MAT'L CLASS	GROUP	DIA	THICK	WIDTH	LENGTH	WEIGHT	STD. COST PER LB.	STD. MAT'L UNIT COST

OPERATION		NO.	MACHINES		JIG OR FIXT.	SET-UP TIME		RUNNING TIME	TOTAL STD. TIME	STANDARD RATES		STANDARD UNIT COST		
DEPT.	NAME		STD.	ALT		ONE SET-UP	PER UNIT			DIRECT LABOR	EXPENSE	LABOR	EXPENSE	CUMULATIVE

STANDARD QUANTITY | OPERATIONS | MAT'L KIND & QUANTITY | STD. COST MATERIAL | STD. RATES L & E | EXTENSIONS | FOOTINGS | FINAL O.K.

TYPE OF MACHINE _____ PIECES USED _____ TOTAL STANDARD COST

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STANDARD MANUFACTURING COST — WORK SHEET
FACTORY No. 1

TITLE _____ CODE _____ BASE _____

TRADE MARK _____ COLOR _____ DYED _____

DATE COMPUTED _____ FIN. WIDTH-INS. _____ RAW WIDTH INS _____

COATING MATERIALS

COAT NO.	MIX NO	COATING CLASS	STD WT 600 YDS	STD. COST PER POUND	STD. COST PER 600 YDS
TOTAL					

COATING MATERIAL — COST SUMMARY

CLASS	PER 600 YDS	PER PIECE	PER LIN YD
TOTAL			

LABOR AND BURDEN

OPERATION	NO OF COATS	LABOR RATE PER 600 YDS	LABOR TOTAL	BURDEN RATE PER 600 YDS	BURDEN TOTAL	LABOR AND BURDEN PER 600 YDS
Raw Fabric Preparation						
Sizing						
Tentering						
Mill Coating						
Pad Roller Coating						
Mangle Coating						
Cement Coating						
Flocking						
Calendering						
Rubbing						
Single Print						
Multi-print						
Embossing						
Splitting and Scalloping						
Inspecting and Rolling						
TOTAL						

TOTAL COST SUMMARY

DESCRIPTION	PER 600 YDS	PER PIECE	PER LIN YD	REMARKS
Fabric				
Coating Material				
Labor & Burden				
TOTAL				

CHART II

CHART ILLUSTRATING THE MAIN PRINCIPLES OF COST ANALYSIS BY MEANS OF STANDARD COSTS

Table I

Basic data		
Capacity:		
1. Man hours		1,500
2. Machine hours		1,000
Budget, at capacity:		
3. Labor, direct	40%	$1,200
4. Burden	60%	1,800
5. Total	100%	3,000

Table II

Standard cost of actual good production			Ratio to Budget
			A
6. Labor	36%	$ 756	63
7. Burden	64%	1,344	74.7
8. Total	100%	$2,100	70
9. Net variation in actual from standard costs - increase			$515.40

Table III

Operations		Ratios to Budget	Ratios to Standard
		A	B
Actual cost:			
10. Labor, direct	$1,058.40	88.2	140
11. Burden	1,557.00	86.5	115.8
12. Total	$2,615.40	87.2	124.5
Actual hours:			
13. Man hours	1,260	84	133.3
14. Machine hours	770	77	103.1

Table IV

Material	Actual Cost	Standard Cost	Ratio to Standard
			B
15. Used	$764.75	$805.00	95
16. Price ratio	-	-	
17. Specified	-	700.00	-
18. Usage ratio			115
19. Cost ratio			109.3
20. Net variation, increase		$64.75	

Table V

Significant ratios (operating signals) and analysis of variations in actual from standard costs

Significance	Ratio	How Figured	Variation	How Figured
Labor:	A		B	
21. Man effectiveness	75	100 ÷ 133.3	$252.00*	33.3 X $756
22. Pay rates	105	140 ÷ 133.3	50.40	5 X 133.3 X $756
23. Cost ratio	140	$1,058.40 ÷ $756	302.40*	$1,058.40 ÷ $756
24. Relation of pay to effectiveness	140	105 ÷ 75		
25. Machine labor effectiveness	77.3	75 X 103.1		
Burden:				
26. Machine effectiveness	97	100 ÷ 103.1	$ 42.00*	3.1 X $1,344
27. Spending rate	86.5	$1,557 ÷ $1,800	243.00	$1,800 ÷ $1,557
28. Degree of capacity used	77	770 ÷ 1,000	414.00*	23% of $1,800
29. Unabsorbed burden			171.00*	$414 ÷ $243
30. Expense index	112.3	86.5 ÷ 77		
31. Rate of production	74.7	$1,344 ÷ $1,800		
32. Departmental effectiveness - labor and burden	87.7	$756 X 133.3 = $1,008 $1,344 X 103.1 = 1,386		$2,394 ÷ $2,100
Material:				
33. Price level	95	$764.75 ÷ $805	40.25	$805 ÷ $764.75
34. Usage level	115	$805 ÷ $700	105.00*	$805 ÷ $700
35. Cost ratio	109.3	$764.75 ÷ $700	64.75*	$764.75 ÷ $700
36. Total variation - labor and burden material		$515.40* 64.75*	$580.15*	*Increase

CHART ILLUSTRATING PRINCIPAL FEATURES OF DIFFERENCE BETWEEN METHODS OF USING STANDARD COSTS (1) AS IDEALS AND (2) AS BASIC MEASURES

CHART III (revised)

NOTE ON CORRECTIONS

Some errors were found on this chart when it was first printed. These were purely clerical errors, in no way affecting the principles being described. As they might be confusing, however, it is desirable to make appropriate changes, which has been done in this copy.

Corresponding adjustments should be made in reading the text, where reference is made to figures in this chart which have been altered, namely:

Chart reference		reads	change to read
43	2d	$46,600	$42,300
"	"	6,950	650
44	2d	85,774	79,474
"	3d	net gain of $3,459, due to the substantial saving made in the purchase of raw material.	net loss of $2,881 due to operating variations, including a saving in the purchase of raw material.
"	"	$11,529	$ 5,189
47	2d	88,916	90,165
"	"	2,060	1,060

I BASIC STANDARD COSTS (MEASURES)

Dept.	Labor	Burden Hours	Burden Rate	Burden Amount	Materials Kind	Materials Q'ty	Materials Price	Materials Amount
PRODUCT "A"								
I	10.00	20	.25	5.00	"X"	80	.50	40.00
II	5.00	10	.50	5.00	"Y"	50	.70	35.00
	15.00			10.00				75.00
PRODUCT "B"								
I	15.00	28	.25	7.00	"X"	140	.50	70.00
II	15.00	26	.50	13.00	"Z"	30	1.00	30.00
	30.00			20.00				100.00
PRODUCT "C"								
I	-	-	-	-	"Y"	100	.70	70.00
II	75.00	100	.50	50.00	"Z"	55	1.00	55.00
	75.00			50.00				125.00

II EXPECTED CHANGED PRICE LEVELS

Labor	90	Material "X"	80
Burden	80	Material "Y"	70
		Material "Z"	60

III STANDARD COSTS (IDEALS)

Revised to expected price levels

Dept.	Labor	Burden Hours	Burden Rate	Burden Amount	Materials Kind	Materials Q'ty	Materials Price	Materials Amount
PRODUCT "A"								
I	9.00	20	.20	4.00	"X"	80	.40	32.00
II	4.50	10	.40	4.00	"Y"	50	.49	24.50
	13.50			8.00				56.50
PRODUCT "B"								
I	13.50	26	.20	5.60	"X"	140	.40	56.00
II	13.50	26	.40	10.40	"Z"	30	.60	18.00
	27.00			16.00				74.00
PRODUCT "C"								
I	-	-	-	-	"Y"	100	.49	49.00
II	67.50	100	.40	40.00	"Z"	55	.60	33.00
	67.50			40.00				82.00

IV ASSUMED ACTUAL PRICE LEVELS

Labor	90	Material "X"	70
Burden	80	Material "Y"	70
		Material "Z"	70

V OPERATIONS

	E Standard (ideal) III		F Transactions	Actual	G Basic standard (measure) I		H Ratio A/SS	J Analysis of ratios
			Department I					90 rates effectiveness
1.	@ 9.00	$ 1,080	120 "A"	$ 1,080	@ 10.00	$ 1,200	90	100
2.	@ 13.50	1,350	100 "B"	1,500	@ 15.00	1,500	100	90
3.		$ 2,430		$ 2,580		$ 2,700		
			Dept II					
4.	@ 4.50	585	130 "A"	585	@ 5.00	650	90	100
5.	@ 13.50	1,215	90 "B"	1,350	@ 15.00	1,350	100	90
6.	@ 67.50	5,400	80 "C"	6,480	@ 75.00	6,000	108	83
7.		$ 7,200		$ 8,415		$ 8,000		
8.		$ 9,630	Total	$10,995		$10,700		
			Burden					
			Total burden					
9.		2,400	Dept. I	1,416		3,000		
10.		5,600	Dept. II	5,294		7,000		
11.	Budget	$ 8,000	Actual Burden	$ 6,710	Budget	$10,000		80 rates effectiveness
			Burden absorbed					
12.	@ 4.00	480	120 "A" 2,640 hrs.	528	@ 5.00	600	88	91
13.	@ 5.60	560	100 "B" 2,940 hrs.	588	@ 7.00	700	84	95
14.	Dept. I	$ 1,040	5,580 hrs. @ 80¢	$ 1,116		$ 1,300	86	93
15.	@ 4.00	520	130 "A" 1,495 hrs.	598	@ 5.00	650	92	87
16.	@ 10.40	936	90 "B" 2,340 hrs.	936	@ 13.00	1,170	80	100
17.	@ 40.00	3,200	80 "C" 8,400 hrs.	3,360	@ 50.00	4,000	84	95
18.	Dept. II	$ 4,656	13,235 hrs. @ 40¢	$ 4,894		$ 5,820	84	95
19.		$ 5,696	Burden absorbed	$ 6,010		$ 7,120	84.4	95
			Material					
			Material purchased					price
20.	@ 40¢	18,000	45,000 "X" @ 35¢	15,750				70
21.	@ 49¢	14,700	30,000 "Y" @ 49¢	14,700				70
22.	@ 60¢	9,600	16,000 "Z" @ 70¢	11,200				70
23.		$ 42,300	Total	$41,650				
			Material used					usage
24.	@ 32.00	3,840	120 "A" 10,560	3,696	@ 40.00	4,800	77	110
25.	@ 56.00	5,600	100 "B" 14,700	5,145	@ 70.00	7,000	73.5	105
26.		$ 9,440	-"X"- 25,260	8,841		$11,800		
27.	@ 24.50	2,940	120 "A" 6,000	2,940	@ 35.00	4,200	70	100
28.	@ 49.00	3,920	80 "C" 8,800	4,312	@ 70.00	5,600	77	110
29.		$ 6,860	-"Y"- 14,800	$ 7,252		$ 9,800		
30.	@ 18.00	1,800	100 "B" 3,600	2,520	@ 30.00	3,000	84	120
31.	@ 33.00	2,640	80 "C" 3,960	2,772	@ 55.00	4,400	63	90
32.		$ 4,440	-"Z"- 7,560	$ 5,292		$ 7,400		
33.		$20,740	Total	$21,385		$29,000		
			Finished product transferred to stock					
34.		$ 7,800	100 "A"			$10,000		
35.			Labor and burden			2,500		
36.			Material "X"			4,000		
37.			"Y"			3,500		
38.		$ 9,360	80 "B"			$12,000		
39.			Labor and burden			4,000		
40.			Material "X"			5,600		
41.			"Z"			2,400		
42.		$15,160	80 "C"			$20,000		
43.			Labor and burden			10,000		
44.			Material "Y"			5,600		
45.			"Z"			4,400		
46.		$32,320	Total					

VI ACCOUNTING UNDER STANDARD "IDEAL" PLAN

(8) Actual labor 10,995; Standard labor 9,630; 1,365 → Labor variation 1,365

(11) Actual burden 6,710; (19) Standard burden 5,696; 1,014 → Unabsorbed burden 1,014

(23) Actual purchases 41,650; Priced at standard 42,300; 650 → Material purchasing variation 650

Material Used (at standard)		Should have been used		Material usage variations
(26) "X" 25,260 @ 40¢	10,104	9,440	664*	1,152
(29) "Y" 14,800 @ 49¢	7,252	6,860	392*	
(32) "Z" 7,560 @ 60¢	4,536	4,440	96*	
	21,892	20,740	1,152*	

*Loss

Closing book inventory 9,746

Work in process (at standard)

Inventory		6,000	32,320 (46) Finished
Production	(8)	19,630	
	(19)	B5,696	
	(33)	M20,740	
		42,066	

Finished stock (at standard)

Inventory		50,000	33,000 Shipments
Production (46)		32,320	
		82,320	

49,320

Raw material (at standard)

Purchased (23)	42,300	21,892 Used

20,408

Control accounts

Cost of sales	33,000		
		56,000	Inventory
		10,995 (8)	Payroll
		6,710 (11)	Burden
		41,650 (23)	Purchases

Total closing inventories 79,474

Profit and loss account

	Product "A"	Product "B"	Product "C"	Total
Net sales	8,570	12,500	20,000	41,070
Standard cost	6,000	10,000	17,000	33,000
Margin	2,570	2,500	3,000	8,070
% Margin	30	20	15	19.6%
Labor variation, loss			1,365	
Unabsorbed burden			1,014	
Purchasing variation, gain				650
Material usage variation, loss			1,152	
Net variation			3,531	650 2,881
"Gross Profit"				5,189

VII ACCOUNTING UNDER BASIC STANDARD "MEASURE" PLAN

Work in process - material:

Raw material (at actual): (23) 41,650 | 21,385 (33)

"X"

	A	S	r	A	S	r	
(26)	8.841	11,800	75	3,000	4,000	75	"A" (36)
				4,200	5,600	75	"B" (40)

"Y"

	A	S	r	A	S	r	
(29)	7,252	9,800	74	2,590	3,500	74	"A" (37)
				4,144	5,600	74	"C" (44)

"Z"

	A	S	r	A	S	r	
(32)	5,292	7,400	71.5	1,716	2,400	71.5	"B" (41)
				3,146	4,400	71.5	"C" (45)

Work in process - labor and burden:

Product "A"

		A	S	r	A	S	r	
	Inventory	1,710	1,800	95	2,295	2,500	91.8	(35)
(1,4)	Labor	1,665	1,850					
(12,15)	Burden	1,126	1,250					
		4,501	4,900	91.8				

Product "B"

		A	S	r	A	S	r	
	Inventory	2,040	2,000	102	3,816	4,000	95.4	(39)
(2,5)	Labor	2,850	2,850					
(13,16)	Burden	1,524	1,870					
		6,414	6,720	95.4				

Product "C"

		A	S	r	A	S	r	
	Inventory	3,920	4,000	98	9,830	10,000	98.3	(43)
(6)	Labor	6,460	6,000					
(17)	Burden	3,380	4,000					
		13,760	14,000	98.3				

Finished stock

	"A"			"B"			"C"		
	A	S	r	A	S	r	A	S	r
Inventory	9,300	10,000	93	19,200	20,000	96	34,650	35,000	99
Production L	2,295	2,500	91.8	3,816	4,000	95.4	9,830	10,000	98.3
A B	3,000	4,000	75	4,200	5,600	75	4,144	5,600	74
M M	2,590	3,500	74	1,716	2,400	71.5	3,146	4,400	71.5
Total	17,185	20,000	85.9	28,932	32,000	90.4	51,770	55,000	94.1
Shipments	6,614	7,700	85.9	11,594	12,825	90.4	21,102	22,425	94.1
Balance	10,571	12,300	85.9	17,338	19,175	90.4	30,668	32,575	94.1

Unabsorbed burden

(11) Actual	6,710	
(19) Absorbed	6,010	700

Total closing book inventories (at actual)

Material	$20,365
Work in process	11,323
Finished stock	58,577
	$90,165

Profit and loss account

	Product "A"	Product "B"	Product "C"	Total	
Net sales	8,570	12,500	20,000	41,070	
Actual cost	6,614	11,594	21,102	39,310	
Actual margin	1,956	906	(1,102)	1,760	
%	22.8	7.2	loss 5.5		4.3%
Less - unabsorbed burden				700	
Actual gross profit				1,060	

CHART IV

EXAMPLE OF A FLOW CHART
SHOWING MANUFACTURING PROCESSES IN REFINING CORN PRODUCTS

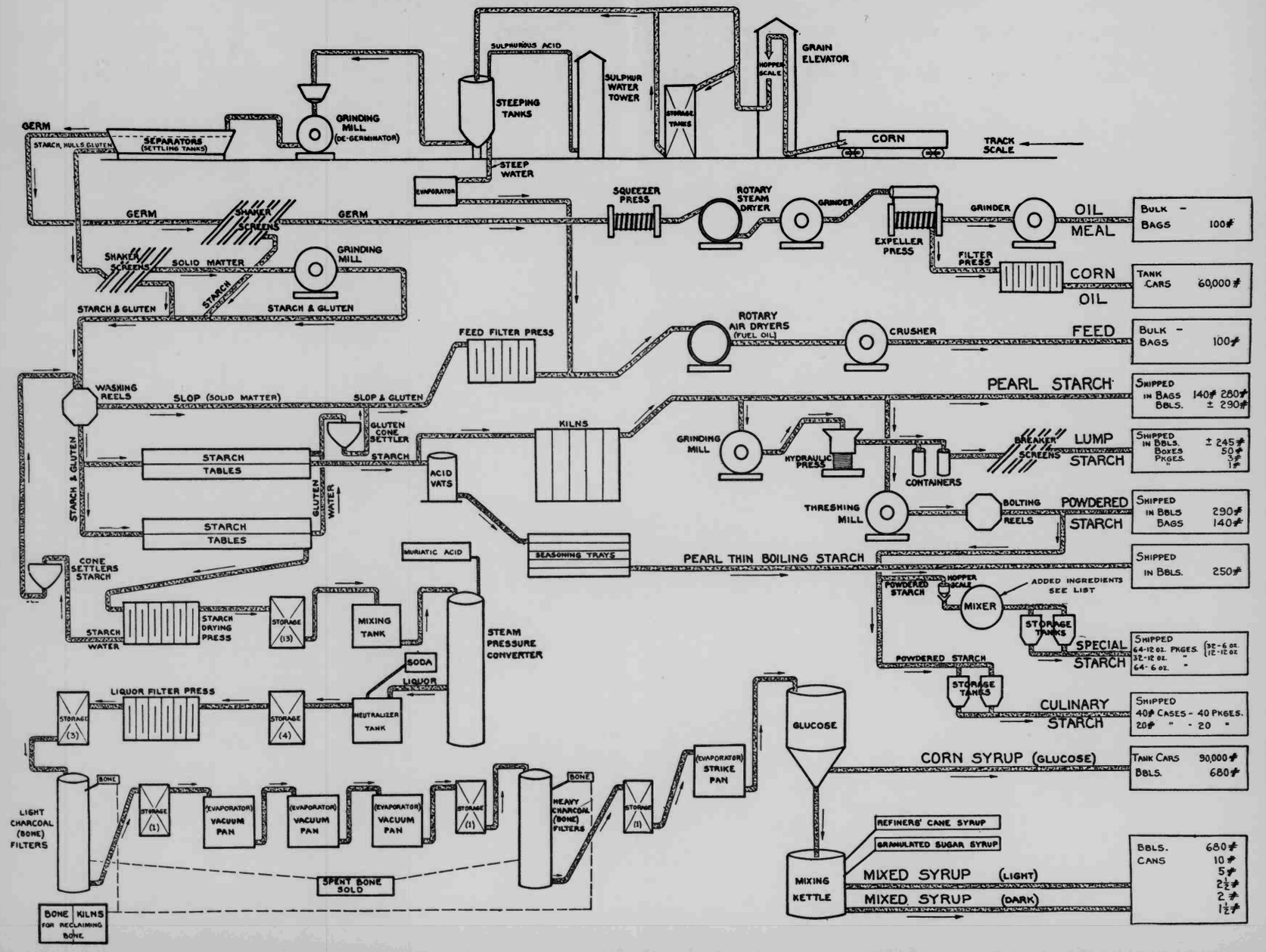
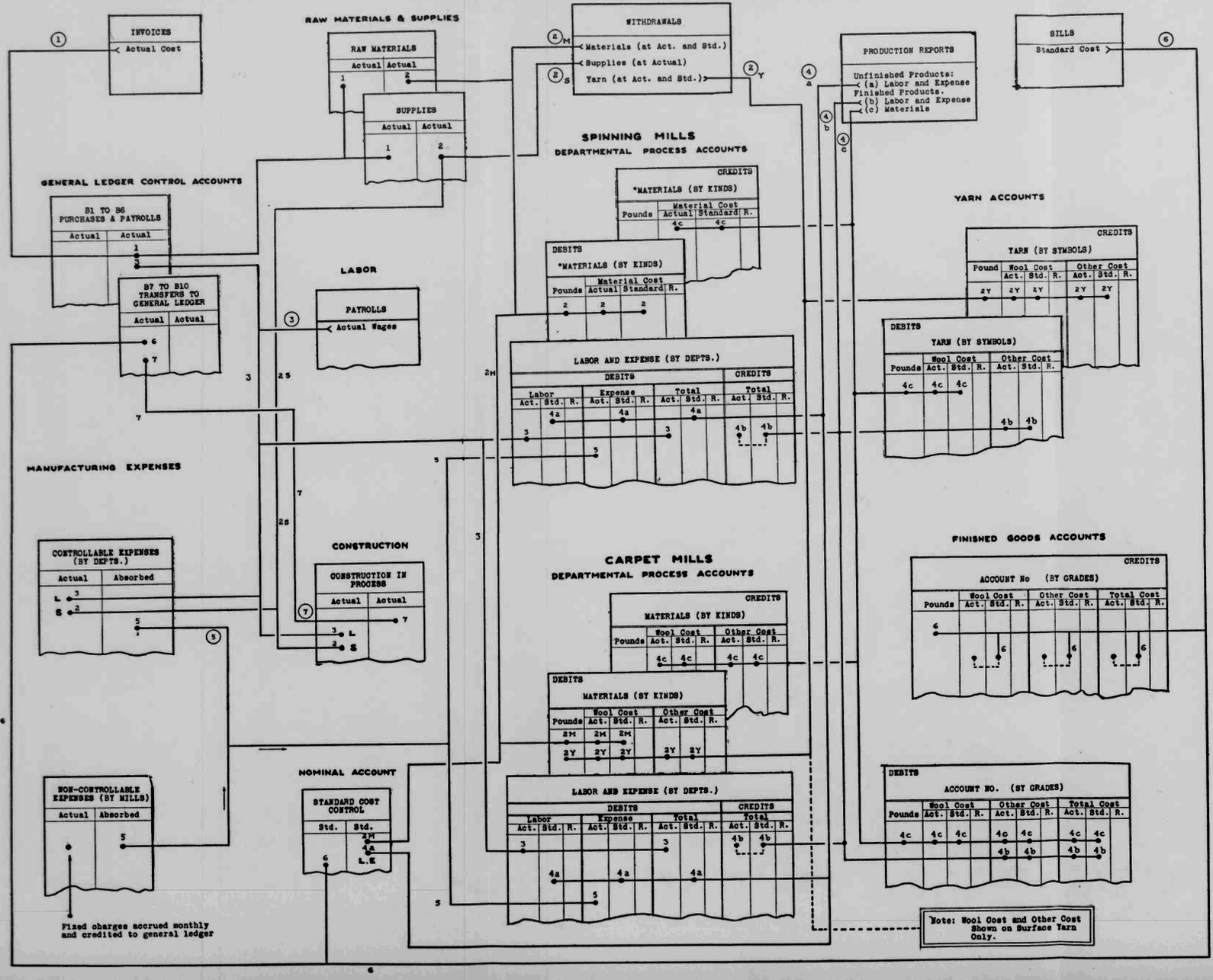


CHART V

OUTLINE OF COST ACCOUNTING PLAN

(Cost Ledger Entries Only)



THE ENTRIES INDICATED BY NUMBERS ON THE ACCOMPANYING CHART COVER THE FOLLOWING TRANSACTIONS:

1. PURCHASES OF RAW MATERIALS, SUPPLIES, AND LABOR ARE SET UP IN THE INVENTORY ACCOUNTS WITH CONTRA CREDITS TO THE GENERAL LEDGER CONTROL ACCOUNTS.

2. RAW MATERIALS AND SUPPLIES WITHDRAWN FROM STORES ARE DEBITED TO PROCESS AND EXPENSE ACCOUNTS, THE RAW MATERIAL BEING PRICED AT STANDARD AS WELL AS ACTUAL. YARN WITHDRAWALS ARE HANDLED IN THE SAME MANNER.

3. WAGES ARE DEBITED TO THE PROCESS, EXPENSE, OR CONSTRUCTION ACCOUNTS AT ACTUAL, WITH CONTRA CREDIT TO THE GENERAL LEDGER CONTROL ACCOUNTS.

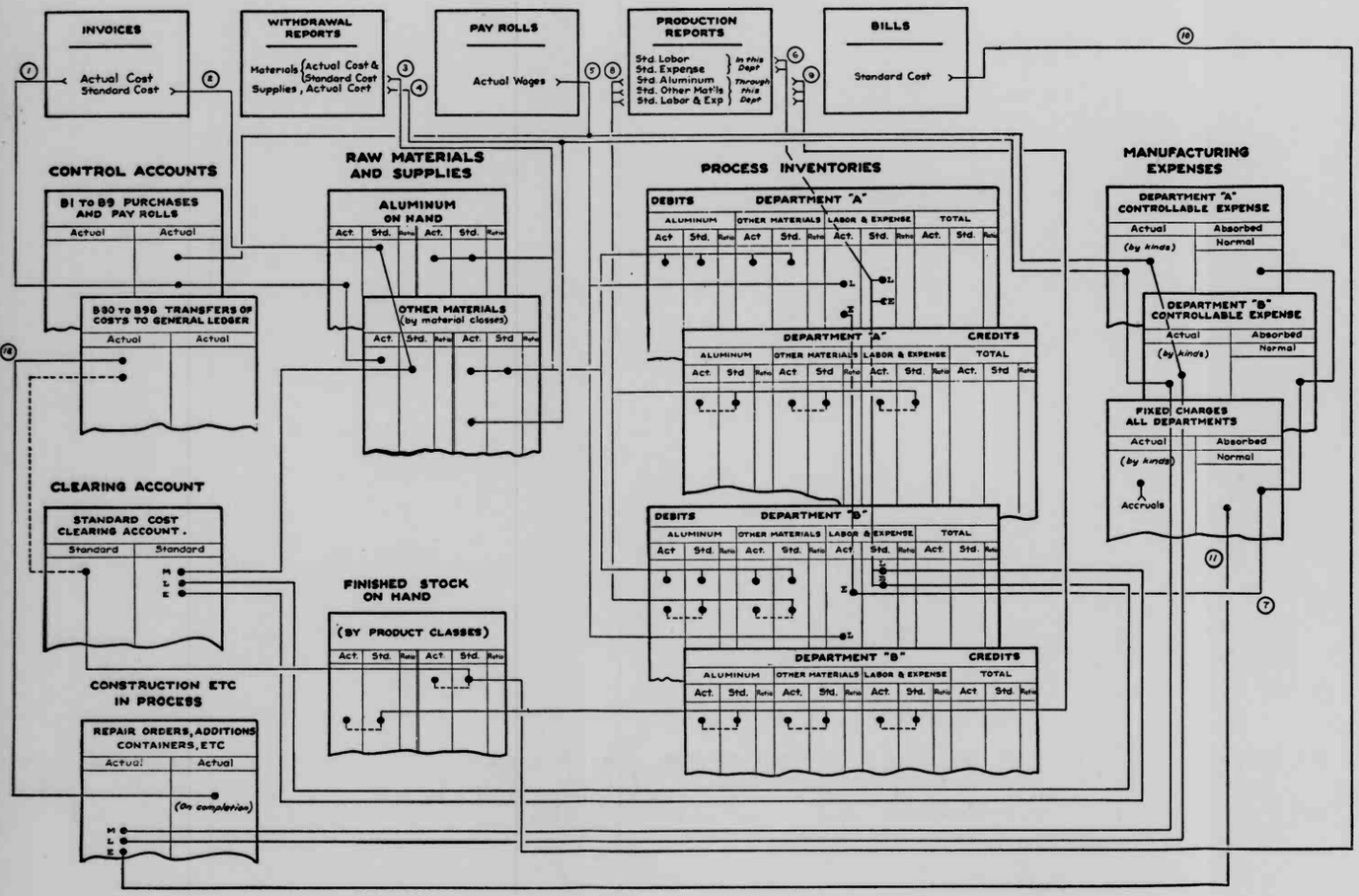
4. DEPARTMENTAL PRODUCTION REPORTS ARE PRICED AT STANDARD LABOR AND EXPENSE AND DEBITED TO THE PROCESS ACCOUNTS, WITH CONTRA CREDITS TO THE STANDARD CONTROL ACCOUNT. FINISHED PRODUCTION REPORTS ARE PRICED AT ACTUAL AND STANDARD, CREDITED TO THE DEPARTMENTAL PROCESS ACCOUNTS, AND DEBITED TO THE YARN AND FINISHED STOCK ACCOUNTS

5. NORMAL BURDEN IS ABSORBED ON THE BASIS OF HOURS RUN, AND IS CHARGED TO THE PROCESS ACCOUNTS UNDER "ACTUAL", WITH CONTRA CREDITS TO THE EXPENSE ACCOUNTS.

6. BILLINGS ARE PRICED AT STANDARD COST AND CONVERTED TO ACTUAL BY APPLYING THE CURRENT COST RATIOS. CREDITS AT ACTUAL ARE CHARGED TO THE GENERAL LEDGER, THE STANDARD CREDIT BEING DEBITED TO THE STANDARD CONTROL ACCOUNT.

7. NEW CONSTRUCTION COSTS ARE CHARGED TO GENERAL LEDGER MONTHLY.

OUTLINE OF COST ACCOUNTING PLAN



THE ENTRIES INDICATED BY NUMBERS ON THE ACCOMPANYING CHART COVER THE FOLLOWING TRANSACTIONS:

1. PURCHASES OF MATERIALS AND SUPPLIES SET UP IN THE INVENTORY ACCOUNTS, WITH CONTRA CREDIT TO GENERAL LEDGER CONTROL ACCOUNTS.

2 STANDARD COSTS SET UP IN INVENTORY ACCOUNTS FOR MATERIALS PARALLELING ACTUAL COSTS, WITH CONTRA CREDIT TO STANDARD COST CLEARING ACCOUNT

3. MATERIALS WITHDRAWN CHARGED TO PROCESS INVENTORY ACCOUNTS AT STANDARD, AND AT ACTUAL DERIVED BY APPLYING COST RATIO STANDING IN MATERIAL INVENTORY ACCOUNTS.

4. SUPPLIES CHARGED OUT AT ACTUAL COSTS.

5 ACTUAL WAGES CHARGED TO PROCESS INVENTORY ACCOUNTS, OR TO EXPENSE AND CONSTRUCTION ACCOUNTS, WITH CONTRA CREDIT TO GENERAL LEDGER CONTROL ACCOUNTS.

6 DEPARTMENTAL PRODUCTION REPORTS PRICED AT STANDARD LABOR AND STANDARD EXPENSE, CHARGED TO PROCESS INVENTORY ACCOUNTS OF THE PRODUCING DEPARTMENTS, WITH CONTRA CREDITS TO STANDARD COST CLEARING ACCOUNT.

7 NORMAL BURDEN ABSORBED UPON THE BASIS OF DEGREE OF CAPACITY ACTUALLY USED, AND CHARGED TO PROCESS INVENTORY ACCOUNTS UNDER "ACTUAL" WITH CORRESPONDING CREDITS TO MANUFACTURING EXPENSE ACCOUNTS.

8 STANDARD ALUMINUM, STANDARD OTHER MATERIALS AND STANDARD LABOR PLUS STANDARD EXPENSE, ACCUMULATIVE THROUGH THE PRODUCING DEPARTMENT, APPLIED TO PRODUCTION REPORTS FOR CREDITS TO THE PRODUCING DEPARTMENT AND CORRESPONDING DEBITS TO THE RECEIVING DEPARTMENTS.

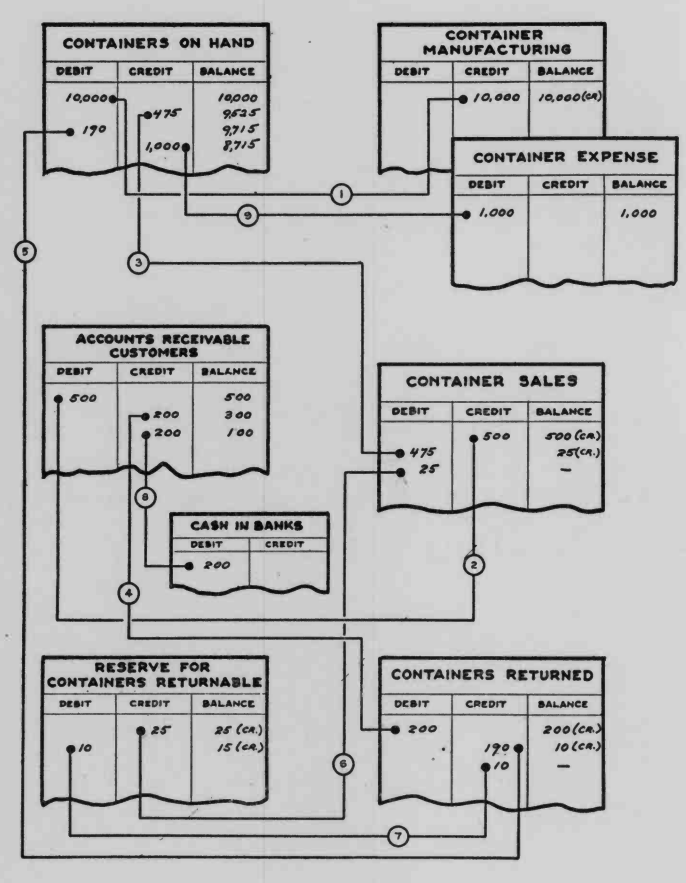
9. SAME AS 8, RECEIVING DEPARTMENT BEING FINISHED STOCK. CREDITS ARE MADE TO THE PROCESS INVENTORY ACCOUNT OF THE PRODUCING DEPARTMENT SEPARATELY BY THE STATED ELEMENTS, WHILE DEBITS TO FINISHED STOCK ARE MERGED IN TOTALS BUT SEPARATED BY PRODUCT CLASSES.

10 SHIPMENTS PRICED AT STANDARD COST AND CONVERTED TO ACTUAL BY MEANS OF COST RATIO STANDING IN FINISHED STOCK ACCOUNT, CREDITING THE LATTER AND CHARGING GENERAL LEDGER CONTROL (COST OF GOODS SOLD).

11. EXPENSE ABSORBED ON CONSTRUCTION COSTS, WHERE PROPER AND DESIRABLE, AS IN THE CASE OF ADDITIONS TO PLANT.

12. CONSTRUCTION TRANSFERRED TO PROPERTY ACCOUNTS, ETC., TRANSFERRED TO GENERAL LEDGER.

SPECIAL PROCEDURE FOR RETURNABLE CONTAINERS



ENTRIES

1. CONTAINERS ON HAND SET UP AT ACTUAL COST.
2. CONTAINERS BILLED TO CUSTOMERS AT A PREMIUM AND CREDITED TO "CONTAINERS SALES".
3. INVENTORY VALUE OF CONTAINERS SOLD, CHARGED TO "CONTAINER SALES" AND CREDITED TO CONTAINERS ON HAND.
4. CONTAINERS RETURNED BY CUSTOMERS, CHARGED TO "CONTAINERS RETURNED" AND CREDITED TO CUSTOMER AT BILLED PRICE.
5. INVENTORY VALUE OF CONTAINERS RETURNED BY CUSTOMERS, CHARGED TO CONTAINERS ON HAND" AND CREDITED TO CONTAINERS RETURNED"
6. EXCESS OF BILLED CONTAINER PRICES OVER INVENTORY VALUE ON CONTAINER SALES CHARGED TO "CONTAINER SALES" AND CREDITED TO "RESERVE FOR CONTAINERS RETURNABLE".
7. EXCESS OF BILLED CONTAINER PRICES OVER INVENTORY VALUE ON CONTAINERS RETURNED CHARGED TO "RESERVE FOR CONTAINERS RETURNABLE" AND CREDITED TO "CONTAINERS RETURNED".
8. REMITTANCE BY CUSTOMER.
9. CONTAINERS SCRAPPED, CHARGED TO"CONTAINER EXPENSE" AT INVENTORY VALUE AND "CONTAINERS ON HAND" CREDITED.

ONCE EACH YEAR A PROPORTION OF THE "RESERVE FOR CONTAINERS RETURNABLE" WILL BE CREDITED TO "CONTAINER EXPENSE". THE AMOUNT SO CREDITED WILL REPRESENT THE PROFIT ON CONTAINERS ESTIMATED NOT RETURNABLE AND WILL BE BASED ON AN EXPERIENCE PERCENTAGE ARRIVED AT AS FOLLOWS:

$$\text{RATIO OF } \frac{\text{CONTAINERS RETURNED, LAST 3 YEARS}}{\text{CONTAINERS SHIPPED, LAST 3 YEARS}} = \text{X (SAY 80\%)}$$

$$\text{PERCENTAGE OF CONTAINERS NOT RETURNED} = 20\%$$

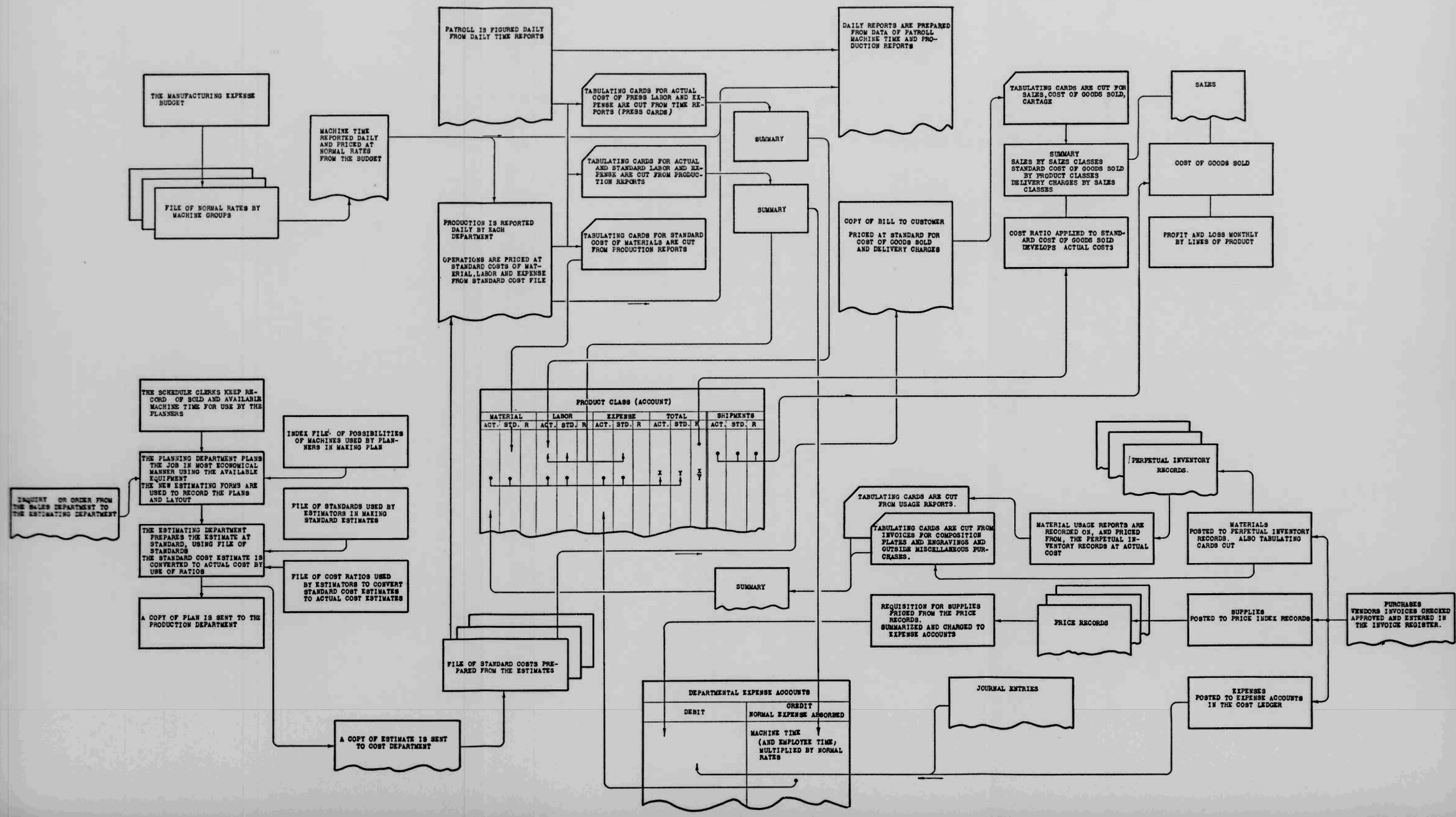
PROFIT ON CONTAINERS NOT RETURNED IS 20% OF PROFIT ON CONTAINERS SHIPPED TO CUSTOMERS (20% OF $25.00 = $5.00).

JOURNAL ENTRY : CHARGE " RESERVE FOR CONTAINERS RETURNABLE " ANT CREDIT " CONTAINER EXPENSE ".

(ALL FIGURES ARE ASSUMED)

CHART XIII

GENERAL OUTLINE OF PROCEDURE



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SOME TYPICAL PRODUCTION REPORT FORMS

_____ PRESS ROOM PRODUCTION

(1) DATE _____
(2) DAY OR NIGHT _____

	1 PRESS NO.	3 MACH. GROUP	4 JOB NO.	5 FORM NO.	6 PRODUCT CLASS	RUN OF RUNS	7 QUANTITY: STRAIGHT PRODUCTION	QUANTITY: OVERTIME PRODUCTION	QUANTITY: TOTAL	8 STANDARD COST: UNIT COST PER 1,000: DIRECT LABOR	UNIT COST PER 1,000: EXPENSE	UNIT COST PER 1,000: MATERIAL	9 TOTAL: LABOR	TOTAL: EXPENSE	10 TOTAL: MATERIAL	STANDARD RUNNING TIME: PER 1,000: DIRECT LABOR HOURS	PER 1,000: MACH. TIME	TOTAL: DIRECT LABOR HOURS	TOTAL: MACH. HOURS	MATERIAL STANDARDS: INK: PRICE PER M	INK: AMOUNT	PAPER: LBS. PER M	PAPER: AMOUNT

DAILY PRODUCTION REPORT AND ANALYSIS OF TRIMMING ROOM OPERATIONS

FACTORY _____ SHEET NO.
DATE

	FABRIC: SYMBOL	FABRIC: WIDTH	FABRIC: D.H.F	CODE OR SPECIMEN NO	FINISH WIDTH	YARDS FROM MEASUR. ROOM	NO OF COATS PER P.C.	PRINTED 12 YARD COATS	TOTAL NO OF 12 YARD COATS	NO OF FACTORY ROLLS	ANALYSIS OF OUTPUT: PRIMES: FULL LENGTH	PRIMES: CUT	PRIMES: TOTAL	2NDS	3RDS	REM	TOTAL SALABLE: 12 YARD PIECES	TOTAL SALABLE: TOTAL YARDS	NET LOSS OR GAIN: LOSS	NET LOSS OR GAIN: GAIN

TOTAL
% TOTAL PRODUCTION
No OF DAYS PRODUCTION

STANDARD COST OF PRODUCTION

Department _____ Month _____ Sheet No. _____ of _____

CABINET NUMBER	UNIT OF PRODUCTION	QUANTITY	STANDARD LABOR: PER 100	STANDARD LABOR: TOTAL	STANDARD EXPENSE: PER 100	STANDARD EXPENSE: TOTAL	STANDARD MATERIAL: PER 100	STANDARD MATERIAL: TOTAL

DAILY PRODUCTION REPORT

DEPARTMENT _____ DATE _____

MILL ORDER	ITEM	Operation No.	Good Pieces Produced	Product Class	Standard Labor		Standard Expense	

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CHART X

TYPICAL PAGE FROM A MANUFACTURING EXPENSE BUDGET

THE X MACHINERY CORPORATION - NEW YORK PLANT

Annual Manufacturing Expense Budget

Recapitulation

Year ending December 31, 19.

No.	Department Name	Total	Indirect Labor	Supervision and Clerical	Repairs and Maintenance: Labor and Expense	Repairs and Maintenance: Supplies and Purchases	Factory Supplies	Heat and Steam	Workmen's Compensation and Liability Insurance	Traveling	Miscellaneous	Depreciation, Taxes and Insurance	°Power and Light	Steam Plant Service	Engineering Department Service	General Plant Expense	General Foundry Expense	General Machine Shop Expense	Patterns, Drawings, Dies, Jigs and Fixtures	New Construction	General Ledger Transfers
	Foundry:																				
01	Cupola	$ 27,950	-	-	1,130	3,120	14,000	-	150	-	-	3,500	2,950	-	-	2,000	1,100	-	-	-	-
02	Coremaking	51,900	12,000	2,200	1,800	250	12,000	-	700	-	-	6,200	1,250	500	-	8,000	7,000	-	-	-	-
03	Molding	130,300	31,500	5,100	4,000	500	10,000	-	1,600	-	-	24,500	4,100	4,000	-	25,000	20,000	-	-	-	-
04	Cleaning Castings	22,600	1,800	1,650	600	150	1,500	-	300	-	-	2,800	1,800	3,000	-	5,000	4,000	-	-	-	-
09	Foundry General	-	18,000	8,000	2,100	900	500	-	400	400	1,000	-	800	-	-	-	32,100*	-	-	-	-
	Total Foundry	$232,750	63,300	16,950	9,630	4,920	38,000	-	3,150	400	1,000	37,000	10,900	7,500	-	40,000	-	-	-	-	-
	Machine Shop:																				
21	Planers	90,250	4,000	5,300	2,900	600	1,900	-	1,400	-	300	27,500	11,000	200	3,000	26,150	-	6,000	-	-	-
22	Millers	58,000	2,300	4,200	2,750	250	1,000	-	800	-	100	18,000	5,400	200	2,500	17,000	-	3,500	-	-	-
23	Drills and Boring Bars	60,200	6,150	5,300	1,800	200	1,000	-	1,200	-	200	15,000	4,850	-	1,500	19,000	-	4,000	-	-	-
24	Grinding	60,900	1,800	1,800	300	100	12,000	-	500	-	150	11,000	4,550	1,100	2,500	21,000	-	4,200	-	-	-
25	Automatics	72,400	8,200	4,500	2,300	1,500	3,000	-	1,500	-	250	21,000	6,250	-	3,000	18,000	-	3,000	-	-	-
31	Forging	27,755	750	1,800	950	600	800	7,800	250	-	75	2,370	580	-	1,000	9,000	-	2,000	-	-	-
32	Heat Treating	44,060	800	2,300	1,120	920	8,300	-	420	-	-	3,400	12,000	3,000	-	10,000	-	2,000	-	-	-
41	Assembly	99,020	3,400	12,000	1,200	600	15,000	-	2,420	-	500	25,100	1,800	500	1,500	32,000	-	3,000	-	-	-
42	Testing	29,760	550	8,000	500	50	2,500	-	210	-	300	4,000	4,650	-	-	8,000	-	3,000	-	-	-
49	Machine Shop General	-	12,800	11,000	1,850	1,020	2,200	-	100	300	250	-	1,180	-	-	-	-	30,700*	-	-	-
	Total Machine Shop	$542,345	40,750	54,200	15,470	5,840	47,500	7,800	8,600	300	2,125	127,170	52,240	5,000	15,000	160,150	-	-	-	-	-
	Internal Service Departments:																				
51	Maintenance and Construction	-	15,000	5,200	19,750*		600	-	300	-	-	1,450	1,800	-	-	-	-	-	-	4,600*	-
52	Tools and Dies	-	13,000	4,800	(18,340*) (500)	100	2,500	-	420	-	-	4,100	1,920	-	-	-	-	-	9,000*	-	-
55	Pattern Shop	-	18,000	2,000	(2,580*) (170)	200	4,000	-	210	-	-	2,250	1,750	-	-	-	-	-	26,000*	-	-
56	Engineering	-	35,000	20,000	-	-	2,300	-	30	3,000	500	600	320	-	15,000*	-	-	-	46,750*	-	-
	Total Internal Service Departments	$ -	81,000	32,000	40,000*	300	9,400	-	960	3,000	500	8,400	5,790	-	15,000*	-	-	-	81,750*	4,600*	-
59	Steam Plant Air Compressors, Etc.	$ -	12,500	2,000	1,400	520	14,000	31,300*	230	-	-	8,000	5,150	12,500*	-	-	-	-	-	-	-
	General Plant Expense:																				
60	General Plant	$ -	23,000	27,000	12,000	2,500	4,000	22,900	850	500	8,000	2,500	6,000	-	-	109,250*	-	-	-	-	-
61	Purchasing	-	-	7,500	-	-	2,000	-	10	2,000	1,000	100	200	-	-	12,810*	-	-	-	-	-
62	Cost Department	-	-	16,000	-	-	2,400	-	15	500	200	200	200	-	-	19,515*	-	-	-	-	-
63	Employment and Welfare	-	-	3,600	-	-	800	-	5	-	700	50	-	-	-	5,155*	-	-	-	-	-
64	Production	-	-	14,000	-	-	2,800	-	10	500	200	750	100	-	-	18,360*	-	-	-	-	-
65	Receiving	-	4,200	2,800	-	-	500	-	30	-	-	1,600	300	-	-	9,430*	-	-	-	-	-
66	Stores	-	8,000	12,000	1,000	150	1,500	-	180	-	-	2,800	1,200	-	-	26,830*	-	-	-	-	-
	Total General Plant Expense	$ -	35,200	82,900	13,000	2,650	14,000	22,900	1,100	3,500	10,100	8,000	8,000	-	-	201,350*	-	-	-	-	-
	Dies, Jigs and Fixtures	9,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9,000	-	-
	Development, Drawings and Patterns	72,750	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	72,750	-	-
	Fixed Charges (Nominal a/c)	-	-	-	-	-	-	-	-	-	-	(188,570*) (188,570)	-	-	-	-	-	-	-	-	-
	Total Manufacturing Expense	$856,845	232,750	188,050	500*	14,230	122,900	600*	14,240	7,200	13,725	188,570	82,080	-	-	1,200*	-	-	-	4,600*	-
	General Ledger Items:																				
81	Shipping	$ -	18,000	4,500	250	70	12,000	200	300	-	300	7,300	1,320	-	-	1,200	-	-	-	-	45,440*
85	Selling	-	-	-	50	10	500	150	-	-	-	2,350	250	-	-	-	-	-	-	-	3,310*
89	Administrative and General	-	-	-	200	30	50	250	-	-	-	4,520	410	-	-	-	-	-	-	-	5,480*
99	Construction in Process	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,600	4,600*
	Total General Ledger Items	$ -	18,000	4,500	500	110	12,550	600	300	-	300	14,170	1,980	-	-	1,200	-	-	-	4,600	58,810*
	Totals	$856,845	250,750	192,550	-	14,340	135,450	-	14,540	7,200	14,025	202,740	84,060	-	-	-	-	-	-	-	58,810*
	In Proof with Exhibit		C-1	C-2	C-3	C-3	C-4	C-5	C-6	C-7	C-8	C-9	C-10	C-11	C-12	C-13	C-14	C-15	C-16	C-17	

*Indicates red figures

Note: ° Electricity is purchased. It is not metered to the departments. The budget for power is based on an estimated consumption at normal capacity, allowing for load factor on rated horse power as indicated by calibration of machines. For light the consumption is calculated according to wattage required.

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CHART XI

TYPICAL PAGE FROM A MANUFACTURING EXPENSE BUDGET

THE X MACHINERY CORPORATION - NEW YORK PLANT

Annual Manufacturing Expense Budget

Department No.21 Planers

	Total Per Annum	Per Cent of Total	Machine Groups: No.1 14 ft to 22 ft.	Per Cent of Total	No. 2 12 ft.	Per Cent of Total	No.3 10 ft.	Per Cent of Total	No.4 8 ft.	Per Cent of Total
Controllable Expenses:										
Indirect Labor	$ 4,000		1,440		1,320		800		440	
Supervision and Clerical	5,300		1,910		1,750		1,100		540	
Repairs and Maintenance - Labor & Expense	2,900		810		850		680		560	
Repairs and Maintenance - Supplies, Etc.	600		200		210		110		80	
Factory Supplies	1,900		700		800		250		150	
Workmen's Compensation and Liability Insurance	1,400		540		550		200		110	
Miscellaneous	300		100		110		60		30	
Total Controllable Expenses	16,400	18.20%	5,700	15.61%	5,590	19.23%	3,200	20.20%	1,910	21.55%
Power and Light	11,000	12.20	4,100	11.22	3,700	12.70	2,150	13.60	1,050	11.82
Internal Service Charges:										
Steam Plant	200	.23	65	.18	60	.22	40	.25	35	.40
Engineering Department	3,000	3.32	1,100	3.02	990	3.40	600	3.80	310	3.50
Total Internal Service Charges	3,200	3.55	1,165	3.20	1,050	3.62	640	4.05	345	3.90
General Plant Expenses:										
Machine Shop General	6,000	6.65	2,300	6.30	1,700	5.90	1,100	6.90	900	10.03
General Plant	26,150	29.00	8,950	24.55	8,800	30.30	5,280	33.40	3,120	35.20
Total General Plant Expenses	32,150	35.65	11,250	30.85	10,500	36.20	6,380	40.30	4,020	45.23
Fixed Charges:										
Depreciation (Buildings)	2,000	-	800	-	500	-	420	-	280	-
Depreciation (Machinery and Equipment)	20,000	-	11,000	-	6,300	-	2,000	-	700	-
Taxes	5,000	-	2,250	-	1,300	-	950	-	500	-
Insurance	500	-	230	-	120	-	90	-	60	-
Total Fixed Charges	27,500	30.40	14,280	39.12	8,220	28.25	3,460	21.85	1,540	17.50
Total Manufacturing Expenses	$90,250	100.00%	36,495	100.00%	29,060	100.00%	15,830	100.00%	8,865	100.00%
Number of Machines			14		15		10		8	
(Normal Capacity - 2000 hours per machine per annum) Machine Hours at Normal Capacity			28,000		30,000		20,000		16,000	
Normal Expense Rate per Machine Hour			$1.31		.97		.79		.56	

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END OF
TITLE